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Color Technique in Industry*

Faber Birren

THE use of color to prevent visual fatigue and increase the mental as well as eye comfort of workers is described by Mr. Birren.

COLOR in industry is a popular subject these days. Hardly anyone would venture to deny its value in aiding good visibility, safety, and human morale. The real problem, however, is less a matter of justifying color than it is of trying to use the head rather than the heart in planning its application.

For color is an emotional thing. There is real difficulty in letting an objective attitude hold the whip hand over purely personal likes and dislikes. All of us have a natural feeling for color. What we prefer is often confused with what we think others prefer and, therefore, should have. Opinions are likely to cloud purposes.

But emotion to the contrary, it is entirely possible to rationalize color without romancing it. For color, as related to factory production and safety, is a science before it is an art. It is not interior decoration in any sense of the word. Appearance is secondary and the mere by-product of a job intelligently done in relieving eyestrain, in minimizing hazards, in establishing ideal seeing conditions, in offsetting fatigue and in otherwise safeguarding the efficiency and well being of labor.

While the basic principles of color in industry may be clearly stated, perhaps the best way of explaining them is to discuss them in terms of actual use. Thus let me describe the specifications for an average factory, and in so doing illustrate how color is engineered to respect good scientific practice.

* This paper, as well as the following one, was presented at the session on Eye Protection, Greater New York Safety Conference, March 23, 1943, under chairmanship of Leonard M. Greenburg, M.D. A third paper, "Wartime Lighting and Safety," by Edwin Vennard, is published in the Edison Electric Institute *Bulletin*, April, 1943, and may be obtained upon request from the National Society for Prevention of Blindness.

"Use more light," says the illumination engineer.

"Make everything white," says the paint authority.

"Give them plenty of color," says the armchair philosopher, "to pep them up and make them happy."

To all of which I say, "Wait a minute!"

Assume, now, that Mary and John Balkan set out at seven in the morning for a defense plant in Bridgeport. A lot could be said about Mary and John, one inexperienced, the other experienced. They are good workers, both of them, and as prone to accident as the rest of us. Naturally enough their day will be spent seeing things with their eyes. And inasmuch as all things seen by the eye are colored, whether gray or red, much importance will be attached to their surroundings.

This is a competent factory. Yet management has had a difficult time with labor turnover and absenteeism and has done something about it with color. So Mary and John part ways at the time clock, to meet again at noon in the cafeteria.

Labor Relations and Morale

Every well-ordered factory should offer an interesting visual "change of pace" to the employee. Most work is monotonous. To use color to relieve emotional tension or fatigue, such spaces as corridors, stairways, washrooms, rest rooms, locker rooms, lunch rooms, should be treated differently from the rest of the plant.

Prescriptions.—Where no particular functions are to be served with reference to critical seeing, good color technique requires that the employee be satisfied with colors he will normally like best or which will establish an appropriate mood. Corridors and stairways in ivory or soft yellow are sunny, bright, and active in stimulation.

Due to the inherent likes of most men and women (as determined by research in color preference and the sale of consumer merchandise) blue is the best color for men's facilities, and soft rose for women's. In cafeterias, peach is the ideal color, being considered the most attractive of all light hues by the average person.

There may be a snicker or two at these remarks. Maybe so, but the management of any factory now beset by high rates of accident, absence, or distressing turnover, might advisedly think twice before taking the attitude that factories are no place for such niceties.

Remember, however, that I am talking about employee facilities, not working areas. And if such spaces are designed for the comfort and convenience of the employee, then it is good science and technique to make the most of them.

Safety is involved too. Where good color stimulates good housekeeping, where it helps to put the worker in an agreeable frame of mind, he naturally is more observant and careful—to say nothing of the fact that a well-designed rest room or washroom will definitely offset visual and emotional fatigue and thus return the employee to his job well rested and alert.

Mary Balkan operates a punch press. She goes from her rose locker room to department 12 of building 3. This is a great, vaulted interior, crowded with machines. Down well-marked aisles she proceeds to plant location 76.

General Factory Areas

Normally all ceilings, girders, and upper walls should be painted white to assure an ample flood of light from above. However, where the worker is placed in close proximity to a wall, this area should not be white. The adjustment of the human eye is regulated by the brightness existing in the general field of view. White walls may constrict the size of the opening of the pupil and hence reduce visibility of dark materials. In such an instance, the extra light gained by the high reflection of the white may be lost by the lowered efficiency of the eye. Also, the human eye is quick in adjusting itself to brightness and slow in adjusting itself to darkness. A white wall (which is meaningless) will thus hold advantage over fairly dark machines or dark materials (which are vital). And it may prove to be an annoying source of distraction and glare.

Prescriptions.—Hold wall tones which are in direct line of vision (up to approximately 8 feet from the floor) in pale hues having about 40 per cent reflectance. Keep such tones very soft and grayish, and preferably "cool" in quality. Remember that color is psychologically attractive. If made too rich or vivid, the attention may wander from the task. Employees may be very happy over colorful surroundings, but for the sake of proper efficiency, it is wise technique to let the environment be passive in order to avoid competition with the job.

Floors

Wherever practical, floors should be fairly light (with a reflectance of 25 per cent or better). Light floors, through multiple reflections, will accomplish much in increasing lighting efficiency, eliminating shadows, and effecting ideal seeing conditions which are devoid of excessive contrasts.

Machinery

Our Mary sits before a well-guarded punch press. Some time ago she nipped off the end of one of her fingers. But that was before the machine had been painted.

Colors for machinery should generally have a reflection value of from 25 to 40 per cent. Where metals such as steel are being worked or formed, colors too light should be avoided lest they: (a) pull the attention away from critical points, (b) produce glare sources, or (c) present unfavorable contrasts which introduce trying pupillary changes. Parry Moon writes: "Investigations of the most diverse kind show that a human being sees best and visual fatigue is reduced to a minimum when the entire field of view is approximately the same luminosity as that to which the fovea (center of the eye) is adapted."

This means that critical seeing demands a fairly uniform level of brightness on machines, walls, materials—all that occupies the field of view. Brightness (despite high light reflection) seldom affords a visual bed of roses. Luckiesh states: "In general, a brighter surrounding field reduces visual efficiency more than one which is darker than the central field."

Prescriptions.—Keep machine colors only *slightly* darker or lighter than materials. Let contrast be effected through hue rather than extreme lightness or extreme darkness. In other words, soft grayish tans will help build up sensitivity for the normally bluish cast of steel; soft grayish blue will heighten sensitivity for the orange cast of brass, etc. The seeing condition can be soft and uniform, and yet the product itself well dramatized and featured.

Shields and Backgrounds

Our Mary no longer looks down a black chute as she operates her punch press. This space is blanked off with a suitable shield

which (a) forms an ideal target, (b) provides contrast with materials behind the point of operation, (c) reflects more light at the critical part, (d) holds her eye to a uniform adjustment, (e) checks annoying shifts in accommodation from near to far, and (f) prevents motion behind the machine from distracting her attention.

High Visibility

Now for John's job. He drives a truck about the plant. His eyes are not concentrated on one thing all day long. He moves about, and if he doesn't watch himself he will run into pillars, knock people in the shins, and otherwise wreck miscellaneous havoc upon himself and others.

Unlike critical seeing tasks which demand prolonged concentration of the eyes in one restricted field of view (and where uniform brightness is essential), the more general safety measures of a plant call for extreme contrast and intensity of color. The marking of aisles, pillars, doorways, dead-ends, the identification of hazardous parts, moving objects, low beams, hot pipes, the regulation of traffic in crowded areas or down dim passageways—all these call for a more vigorous technique.

Most people in industry and safety are not aware of the fact that red (the traditional hue of danger) ranks pretty low in visibility. In fact, under very dim light, red is the first color to lose its identity and to melt away into nothingness.

Prescriptions.—Yellow is the color of highest visibility in the spectrum. Next in order is yellow-green, then orange, then red. While white holds its brightness under all lighting conditions, it lacks impulsive attraction to the eye and hence is not very compelling.

Good safety practice therefore will keep such functions and purposes as these in mind:

1. Yellow, being the most conspicuous of all colors, should be used where hazards are critical—off-and-on switches, danger zones, low beams, moving parts, etc. And if yellow is to be given real significance, it should not be used promiscuously lest it "cry wolf" in meaningless places and thus be disregarded where the "wolf" may actually lurk. Yellow may thus be No. 1 in a system of color for safety.

2. Yellow-green and orange, No. 2 and No. 3, may then be given other jobs to do—curbing, rails, boxes, cranes, trucks, etc. Order and significance may thus be intelligently worked out, with color employed for a specific rather than random impression on the worker. Yellow he watches with a wary eye; yellow-green he avoids somewhat gingerly; and orange he knows must merely be respected —for the dangers marked by each color have this relative importance.

3. Red may logically be reserved for fire apparatus, fire doors, exit signs, lines, etc. This acceptance is today universal and should no doubt be preserved.

Color system is thus meaningfully employed. Aisle marks keep traffic well regulated. Dado stripes at eye level guide employees down stairways and along corridors. White corners discourage littering. Red squares painted on the floor under fire extinguishers prevent obstruction. Alternate black and white stripes mark dead-ends, pillars, doorways. All these precautions have sense and reason to them. The worker is kept alert, his wandering moods arrested, his intelligence and instinct guided. And the plant, incidentally, looks very pretty.

Conclusion

So Mary and John meet at noon in the peach cafeteria. And that night they meet again, one from a rose locker room, the other from a blue, to walk down an ivory hued stairway. Weary, of course, but not too depressed over thoughts of tomorrow and the same thing all over again.

They perhaps do not realize it, but color has done much to make them the efficient and good workers they are and ought to be. They are workers free of all possible hazards. They are provided with a cheerful environment, free of monotony—for Mary, a "cool" working atmosphere, uniform in brightness, her machine individualized in its surroundings, her task well defined and visible; and for John, a safe plant with all its danger spots clearly indicated.

Both of them have relief from fatigue, a finer attitude, an inward pride.

Perhaps many accidents are due to carelessness. And maybe you can put your finger on this or that and say that color doesn't mean a thing. Yet color, intangible though it may seem, has a lot

of magic to it, like the "want of a nail." Surely abuse of the eyes may not be too remotely connected with the "header" a worker may take down a flight of stairs. A sick stomach (resulting in a day off) may be due less to a salami sandwich than to the struggle of trying to see under conditions of excessive contrast or glare. A lost finger or hand in a guarded or unguarded machine may, without too much imagination, be traced to a fatal indifference brought about by surroundings that might discourage any mortal of high or low forehead.

While many safety measures demand a necessary gadget or guard, discipline, training, education, rule or law, color has this to its great advantage—that all people love it and react to it without having to exert the least mental effort.

Discussion

QUESTION: When the walls are the same color or nearly the same as an aluminum wing being worked upon, is there any danger of the working surface being lost in the background?

MR. BIRREN: In a photograph it might be lost, but don't forget the eye sees a lot of things besides color. It sees things in terms of distance, in terms of space relationships. Many times when color plans are made this fact is forgotten. It is elemental that if you want to look for something which is white and you have the white in front of a black background, you may see it more easily. But if you were to look at it all day long, it would be excessively tiring.

I don't mind camouflaging a product in its environment. In fact, you have to camouflage where you are working with a colorless material. You rely on space relationships to have it stand out clearly. The thing that I think is often overlooked is that if you are working—and I think of a critical seeing test—at driving rivets into a plane's wing, there is absolutely no need of putting yellow marks around every hole to build up a strong seeing condition with contrast, simply because the man is concentrating all day long, eight hours a day, and you don't need brilliance in color. You only have to use strong contrasts—red and blue, and white and black—where you have to shock the worker into an attitude which he does not have, working at his task. In the case of the grayish walls and the aluminum wing, if there were a strong difference it would cause

the worker to look away from his job, particularly if he could look away at color. We rely on space relationships for him to know that the wing is there.

QUESTION: What effect is there from a man's constantly staring at blacked-out windows? What effect has that on a man who works mostly with aluminum and gray walls?

MR. BIRREN: It has a bad effect. Any excessive contrast in light and dark is very trying to the eye. But if you were to choose between an open and a blacked-out window, the blacked-out would be less a source of eyestrain than the open window. The worst trouble caused by blacked-out windows is that they generally decrease the amount of light in the factory which is not geared up to work without open windows. I have been in plants where the level of illumination was less than a half foot-candle because they blacked out all windows. Of course, eyestrain increases as the level of illumination decreases, particularly as you go down around three, two and one foot-candles.

So I would say the blacked-out window is not a source of eyestrain, but the lack of illumination is.

QUESTION: Of course, in the summertime the windows will all be open and the sunlight will be coming in. But we also have a very direct light from these fluorescent tubes which are set at a low level above our machines and are very numerous. Would there be any indirect effect on that?

MR. BIRREN: Certainly. If it is humanly possible to do so when blacking out those windows, paint them white or a light color on the inside of the plant.

QUESTION: As a physician—in the operating room we use that light green—I should like to hear a little more about the green. Of course, the yellow-green was mentioned, but we call this light green. How does that come into the picture?

MR. BIRREN: The painting of machinery in tan to build up the sensitivity of the eye to steel, and the use of blue to build up the sensitivity of the eye for brass and copper—these practices are taken directly from the development of blue-green in operating rooms, which was done some twenty or so years ago.

I happen to be somewhat familiar with this work. In fact, I did

a great deal of hospital planning just about fifteen years ago, when this blue-green operating room was being introduced.

Blue-green in an operating room serves two chief functions: first of all, it eliminates too much brightness over the walls—eliminates glare; and second, it provides a field of visual relaxation. The surgeon ordinarily is concentrating on a very small field of view and looking at a light intensity sometimes as high as a thousand foot-candles in the field of operation. Blue-green was established as a direct visual complement to the color of coagulated blood, so I am told. After the retina of the surgeon's eye had been tied to this red color, by looking at blue-green the sharpness of his vision is restored.

This, incidentally, is a good practice. It has been followed in industries working with specific colors. You can always work with complements. The big advantage of working with complements is that you do not have to rely for good visibility on light and dark contrasts. You can keep your brightness ranges pretty much the same and build your visibility up through color contrasts. The big advantage is that you do not need light and dark contrasts. These are the conditions which are hard on the eye. If there is any device you can follow to keep the brightness level the same and yet be able to see two different things with the aid of color, then you achieve an ideal result.

Incidentally, complements are very pleasing to the eye. People like them. Wherever you can use color with function or with a purpose in mind, people like it.

Behind the Scenes of a Successful Eye Safety Program*

A. G. Bungenstock

THE author presents practical suggestions for carrying on an eye safety program in industry.

THERE comes a time in every safety engineer's life when he realizes how inadequate his eye protection program is—when he goes through the shop and sees community goggles hanging on grinders, or when he gets a series of complaints that the glasses he has issued for protection are too heavy, they fog up, they hurt people's eyes, they are not sufficiently transparent, and so on through the entire gamut of complaints. And then he begins to wonder how effective his program really is—and so is born the resolve to do something about it.

First of all, the safety engineer has to determine the need for an eye protection program in his own plant. How many accidents occurred last year? Not how many eyes were lost, but how many potentially serious accidents were there? If there was only one, an eye protection program is needed.

I think it is wise to decide right at the start to do the job right. I should begin by surveying every job in the plant—and I mean *every* job. The safety engineer should look at the possibilities on each job of having a worker's eyes hurt, and then determine from these possibilities the types of protection that must be given.

Then he should chart that protection in very definite form. Some of the workers are going to need just the spectacle type of glasses. Incidentally, I like the term "safety glasses" better than "goggles." It is an added plug for safety. Other employees are going to need side-screen safety glasses. Of course, those working

* See footnote on page 3.

with acids are going to need acid safety glasses. Others will need cup-type safety glasses on their jobs. Every job should be charted, and beside the chart should be indicated the eye protection that is recommended.

Then, an oculist and an optician should work with the safety engineer. They should be brought into your plant, if possible, on a part-time basis if not on a full-time basis. There are very definite reasons for this. A certain percentage of prescription safety glasses will be required if the job is to be done right, and for that an oculist is needed. If he can do the eye examinations in the plant itself, a lot of time and money can be saved. After both the prescription and plano glasses have been obtained, an optician is needed to fit them. With all due respect to the storekeepers who hand out these glasses in most plants, they are not trained to do a good job. If safety glasses are comfortable, half the battle is won in getting people to wear them.

It is necessary to plan for adequate examination rooms, fitting rooms, and storerooms for spare parts and spare glasses.

The next step is to find out what eye accidents have cost during the past year. It is well to make a careful estimate of the cost of the new program. Then the idea must be sold to management. I don't think there should be much trouble in doing this if a logical, clear-cut, concise picture is presented of what the program is going to cost, and what it will save. It should not be very difficult to convince management that adequate eye protection is necessary.

The first step in setting up a program is to present in writing the charted safety needs of every job to every supervisor in the plant. If the facts are presented in writing, he cannot dodge the responsibility of seeing that the correct safety glasses are worn on each job, as indicated on the chart. Then rules should be set up for him. Four that have been used and found adequate are presented herewith:

Responsibility rests with the supervisor to:

1. Equip his employees with the necessary, authorized personal protective items
2. Instruct them in the proper use of such equipment
3. Require the wearing and use of protective equipment
4. Require that it be properly maintained, adjusted, and replaced when necessary.

Many people complain, "Well, I can't get the men to wear safety glasses." But isn't that just anticipating trouble? When there is a new job to be done in a plant, the layout men make a layout of the machines, the materials, and the processes that will be necessary for that particular job; the workers don't come in saying, "I don't think this job should be run this way; I don't think we should use this type of material." They accept the specifications drawn up by experts. Why cannot it be written into the specifications—along with the type of material and the process of the work—that for this particular job a certain type of eye protection is mandatory? Let it be assumed that the eye protection is part of the job layout. If it were approached from this angle, there would not be too much trouble.

The safety engineer has to do a selling job. After he gives the supervisor the chart and tells him what is required on the job, he has to sell him on the idea. He cannot just hand over the chart and say, "Here it is, Brother. They are going to wear them." He must tell the supervisor why he should be interested in the eye protection program. And once he is won over, 90 per cent of the problem is solved, because the supervisor can make or break the program. It will pay to give a lot of attention to the first-line supervisor.

Then there is the plant optician. Every time he fits a pair of glasses he can do a selling job for safety. He can tell the employee what the plant is doing to conserve his eyesight, and convince him that he should come back any time that his safety glasses need adjustment.

Employees must be taught to take care of their safety glasses. So many of them lay a pair of glasses down so that the lenses become scratched. After a few scratches appear, visibility is cut down to the extent of distracting the individual who wears them. The employee must learn to use his glasses correctly and not to abuse them. He must learn how to clean them.

The plant oculist also performs valuable service. Not only does he do the refraction but he does a retinoscopy, by which he can pick up many cases of the beginning stage of eye diseases. In this way he can advise the employee to consult his own doctor, and the condition is discovered in the early stages, before it becomes critical.

It stands to reason that work efficiency is increased when effort is made to improve the eyesight and safety of employees, through provision of prescription safety glasses.

"All this is costly and the cost might be prohibitive," is the fear expressed by management at times. Let me give you a few figures for the last two years, for the Western Electric Company. In the past two years we have issued about 3,700 pairs of prescription glasses and about 18,000 pairs of planos (regular safety glasses with no correction). In all, it adds up to almost 22,000 pairs of safety glasses, which, with the cost of the oculist and optician and a few minor expenses, have cost about $58,000. But for that same period of time I have on my desk 24 pairs of safety glasses in which the lenses are shattered. Every one of them undoubtedly saved an eye! (As a matter of fact, there must have been at least as many cases again in which the impact of the flying body might have been enough to blind an unprotected eye but was not enough to crack the safety lens, and these would not be brought to me.)

The normal compensation rate and all the attendant expense for the loss of an eye runs to about $3,000. At that rate, 24 eyes would have cost us $72,000. We spent $58,000. Purely from a profit-and-loss standpoint, we saved $14,000. But a more important consideration is that these 24 employees still have unimpaired vision. Their earning power has been preserved for the rest of their lives; they have been saved the intense mental and physical suffering attendant on the loss of an eye. It is no exaggeration to say that the administration of a good eye protection program will pay dividends beyond measure.

Discussion

CHAIRMAN GREENBURG: I am sure there are some questions for Mr. Bungenstock from an audience of this size and I am certain that a few of them are of the stereotyped nature: What do you do when a man complains about fogging? What do you do when they say the goggles are too heavy? What do you do when they say they are uncomfortable and don't fit? If there is anybody in the audience who has any real or fancied objection to the use of safety glasses, I think we ought to try to bring it out now and see what we can do to lay its ghost low.

QUESTION: The question I have in mind is in connection with the refitting of goggles. Suppose a man, after having a pair of goggles fitted, later decides that they are not right and wants them refitted. Would you suggest that he leave the work floor and go to the fitting room you spoke of, or would you suggest a patrol by the oculist equipped for emergency repair work of that nature?

MR. BUNGENSTOCK: By refitting you mean just a minor adjustment in the fit of the glasses themselves, not a change in refraction?

QUESTION: I mean adjustment of the glasses. For instance, the safety engineer, in his patrol of the plant, notices this man not wearing his goggles, and in conversation with him receives the excuse that the goggles do not fit. They fitted originally, yes, but they don't fit now.

In an instance such as that, would you suggest a patrol of the plant by the oculist or would you suggest that the worker take the time to go to the fitting room?

MR. BUNGENSTOCK: I would suggest that the worker take the time to come to the fitting room and let us fit him. We have found that this works out, unless the optician happens to be working in that vicinity fitting a group of new employees with plano lenses. Then he can stop and pick up this complaint and make the adjustment. Either way would work, but if you have a choice I would say let him come to the fitting room.

QUESTION: What if the complaint is just used as an excuse on the part of the employee to get away with not wearing goggles.

MR. BUNGENSTOCK: You can soon find out whether or not it is an excuse and do something about it then.

QUESTION: Do I understand that your company pays for the prescriptions of your employees?

MR. BUNGENSTOCK: That is right. We stand the entire cost.

QUESTION: I should like to ask a question concerning prescription glasses. Suppose we have 100 girls and ten of them wear prescription glasses anyway. We go to work and sell glasses to them. Do you suggest that we examine the eyes of the other ninety?

MR. BUNGENSTOCK: Not necessarily, unless they are complaining of some discomfort. If they have not worn glasses previously, I would not have them examined.

QUESTION: I should like to ask what number of employees do

you think there would have to be in order for it to be a paying proposition for a full-time optician.

MR. BUNGENSTOCK: Well, of course, you have a big job if you are just starting this program and you have not done it before. You have a big job fitting all the personnel at the beginning. But after you have gotten them fitted and you simply have to take care of new employees coming in, or replacements. Well, with eight to ten fittings of planos an hour, you can figure the amount of time you are going to need for an optician's service.

QUESTION: In the case of breaking a pair of prescription glasses which cannot be replaced for three or four days—then would the optician come in?

MR. BUNGENSTOCK: In that case the employee probably has a pair of his own glasses and we would let him wear those and put a pair of cover-alls over them until we can get him a pair of prescription safety glasses. We can get them pretty fast, thanks to the good services of optical companies.

QUESTION: Has the subject of adjusting prescription safety glasses to the working distance been considered? In general, the whole question of working distance has been very much overlooked in the matter of prescription glasses.

MR. BUNGENSTOCK: We have taken that into consideration and we use our oculist's advice. In some complicated cases we have had to go to trifocals where there were two different working distances on a particular job.

QUESTION: Do you think that it is necessary for the oculist to know something about the work that is being performed in order to make the proper fitting of prescriptions?

MR. BUNGENSTOCK: Very definitely.

SAME QUESTIONER: In other words, it would not do to send someone to an oculist just for prescription fitting unless the oculist knew something of the work?

MR. BUNGENSTOCK: The oculist should know whether it is a drill press job or what type of job the man is doing, and if he has any doubts, he will go out and look at the job and measure the working distances.

SAME QUESTIONER: That oculist, of course, would be the man in the shop. We are assuming that we are sending someone outside.

MR. BUNGENSTOCK: Then you can supply him with all the necessary details. Tell him what the working distances are.

SAME QUESTIONER: The type of prescription form that these various companies use does cover that, I imagine.

MR. BUNGENSTOCK: Yes.

QUESTION: Could you suggest one or two methods to persuade the employee that he needs goggles and that he should wear them?

MR. BUNGENSTOCK: What are you talking about now—a fellow who is on a job that requires the wearing of safety glasses and yet does not want to wear them?

SAME QUESTIONER: That is right.

MR. BUNGENSTOCK: Well, as I said before, I think your first attitude is the important one. If you convey to him the idea that you have set up the job a certain way, using a certain type of material, and say that on this job a certain type of eye protection will be worn—and if you say all this in a positive manner—you diminish the complaints by about 60 to 70 per cent right off the bat. You will get recalcitrant people who don't want to wear them. You will just have to go to work and sell each one individually on the idea. You can do that through a number of different approaches. You might, for instance, if he is a family man, appeal to the fact that he has no right to jeopardize the welfare of his family by taking a chance himself. If he has any youngsters and has planned for their education, he has made those plans on his present or increased earning power and he has no right to jeopardize them by an unsafe act. You can use any number of appeals. Get under his skin in some way and make him see that he is being selfish by refusing to be safe. You can sell him.

QUESTION: I can understand the need for individual glasses where a man is working on a certain operation all the time, but how about the situation in a small plant where one day you take two or three men to do, for instance, a chipping job on concrete and the next week you might take two or three entirely different men? Can the community goggles be used in a certain way to overcome that problem?

MR. BUNGENSTOCK: No, sir, I would never advocate the use of community safety goggles. Safety glasses are so cheap that you

can afford to equip every man in your plant with his own individual pair.

SAME QUESTIONER: Even though he may use them only once in a while?

MR. BUNGENSTOCK: Even if he uses them only one day a month, it is cheap insurance. A pair of plano glasses costs you about $1.50 and they will last indefinitely with proper care. You may have to replace a scratched lens and so forth. But for $1.50 you are saving a possible cost of $3,000 compensation, and that is cheap insurance.

SAME QUESTIONER: This idea of prescription glasses is new to me. Is it not possible to use the regular goggles in conjunction with the man's own glasses? How serious a proposition is that?

MR. BUNGENSTOCK: Well, I will tell you. Try it yourself sometime if you wear glasses. Put your regular glasses on and over them put a pair of cover-all glasses and wear them for eight hours and see how comfortable they are. I think you will be sold on the idea of prescription safety glasses.

QUESTION: Do you advocate 100 per cent use of safety glasses in the entire plant?

MR. BUNGENSTOCK: It may not be entirely necessary, although the trend seems to be that way. If you are honest in your analysis of jobs, and insist that you protect the men by the use of safety glasses wherever there is the slightest doubt, I think you will be all right. Of course, to play perfectly safe the thing to do would be to put them on every individual who comes into the plant.

QUESTION: How would you handle the problem of a man who has four or five different jobs in the course of a day and is exposed to different hazards on each job?

MR. BUNGENSTOCK: Do all of the jobs require the wearing of safety glasses?

SAME QUESTIONER: Yes.

MR. BUNGENSTOCK: Then give him a pair and let him use them on all of the jobs. Or don't I get your question? Was that what you had in mind?

SAME QUESTIONER: No, they might be different types of hazard. He might be welding for an hour or two and then he might go on a chipping job.

MR. BUNGENSTOCK: Then you will have to provide him with the type he needs on each job. It may mean giving him four or five pairs of safety glasses, but that is still cheap.

QUESTION: I should like to hear a little about safety glasses on men doing steam jobs.

MR. BUNGENSTOCK: Where you get a possibility of fogging?

SAME QUESTIONER: Yes.

MR. BUNGENSTOCK: There are certain chemicals on the market —antifog pencils—which do a very effective job for a period of one to three hours, even on the foggiest types of wash jobs and steam jobs, and I think you will find that if you will teach the men to renew that antifog compound at regular intervals, your glasses will stay free of fog.

QUESTION: Do you recommend safety glasses for office workers at any time?

MR. BUNGENSTOCK: No, we do not unless they happen to be engineers who go into the shop frequently and are exposed. Then when they go into the shop they must wear them.

QUESTION: How do you handle the fellow who habitually loses his glasses?

MR. BUNGENSTOCK: Make him pay for them.

QUESTION: Talking about prescription glasses, a lot of safety supervisors favor the clip-on type. What is your opinion?

MR. BUNGENSTOCK: I don't think you get the strength that you get from the regular type of safety glasses. You have a hardened lens but you also have a retaining ring or frame in which these lenses are set. The lenses may shatter, but they will be retained in the ring. You don't get that strength in a clip-on safety glass, and so I prefer to have them in a regular frame.

QUESTION: Do you feel that it is necessary for the company to buy the prescription glasses? In other words, the ordinary goggles are free—that is part of the setup—but prescription glasses belong to the individuals themselves and may be taken with them if they quit the job. Is that so?

MR. BUNGENSTOCK: If he wants to take them with him when he leaves we charge him a nominal sum, the equivalent of the cost of a pair of planos.

SAME QUESTIONER: There wouldn't be anything the matter with

having the men pay for them in the first instance. We could pay for the frame if they buy the lenses.

MR. BUNGENSTOCK: It is such a small matter. But you will get a better psychological attitude if you pay for them first. They don't cost much, and you will have a better chance of getting them worn.

QUESTION: How do safety shields for eyes compare with safety glasses?

MR. BUNGENSTOCK: They do a good job in lots of places where other parts of the face must be protected, but I would never use a safety shield as a substitute for glasses. I would use it sometimes in conjunction with glasses, but never as a substitute.

An Eye Health Program for Schools

PREPARED by members of the Society's staff, this article discusses briefly correct school environment, equipment, responsibility of personnel, and community co-operation in solving eye health problems of school children.

THE general objective of a school eye health program is to promote eye health and efficiency and to protect the eyes and the sight of pupils in elementary and high school in every way that lies within the scope of the functions of the school.

The health of the child is primarily the responsibility of the parents, but the school and the community must share that responsibility by making healthful living possible in all aspects of the child's life.

To be able to fulfill its obligations for eye health the school must have certain specific objectives in mind.

Correct School Environment for Eye Health

The first objective of a school eye health program is to provide a school environment in which all parts of the plant will contribute to the health, safety, efficiency, and comfort of the eyes of pupils, administrators, and teaching personnel.

Orientation of school buildings should be determined by climatic conditions, but buildings should be so constructed as to insure a maximum of daylight and absence of glare in every room. In addition, artificial illumination should be provided to supplement daylight on dark days and for general use in parts of the room not receiving adequate daylight illumination.

The amount of light should be determined by the visual task to be performed, the eye condition of those performing the tasks, and the length of time the visual effort is to be sustained. Although the amount of illumination is a somewhat individual matter, a

minimum is recommended under which no pupil should be expected to undertake work requiring close use of the eyes. *American Recommended Practice of School Lighting** sets this minimum at 15 foot-candles.† For prolonged or intensive eye work or for pupils with eye defects, increased illumination is necessary. Quality of illumination is quite as important as quantity. Light should be properly directed, diffused and distributed, and should be free from glare.

Quantity and quality of natural illumination depend on placement of windows, glass area, and control of light. It is desirable to have windows on one side of the room to the left of the pupils. Glass area should be at least 16 per cent, preferably more, of the floor area. The best light comes from the top of the window; hence it is essential for pupils seated on the far side of the room that the glass area should reach as near to the ceiling as possible.‡

Natural illumination should be controlled by shades that transmit diffused light. The most desirable arrangement is the placement of two buff or gray shades at each window, with rollers at the center, the space between being protected by a V-shaped bar. Shades should be wide enough to prevent streaks of light at the side.

The system of artificial illumination to be installed should be determined by a lighting expert. It should meet accepted requirements for quantity and quality, and should be adapted to the type of work carried on in each room. Classrooms, workshops, sewing rooms, laboratories, cafeterias, and gymnasiums may all require different types of illumination.

The decoration of rooms has a decided effect on quantity and quality of illumination. Clean white ceilings and light-colored walls reflect far more light than dark tones. Dull finishes should be used to prevent the possibility of glare.

* Illuminating Engineering Society and The American Institute of Architects, *American Recommended Practice of School Lighting*. New York, Illuminating Engineering Society, 1938.

† Foot-candle: unit of illumination; the direct illumination on a surface which is everywhere one foot from a uniform point source of one international candle. Inexpensive meters for testing quantity of illumination may be obtained from the General Electric Co., Nela Park, Cleveland, Ohio, and from the Weston Electrical Instrument Corporation, Newark, N. J.

‡ A check list may be obtained from the National Society for the Prevention of Blindness, 1790 Broadway, New York, N. Y.

In workshops it will be necessary for parts of the machines to be painted in contrasting colors to enable those working at them to identify such parts easily and to judge depth and distance.

Maintenance is an important factor in illumination. Accumulation of dust on windows, transoms, walls, ceilings and luminaires will cause a rapid decrease in the efficiency of even the most approved lighting system. Lamps deteriorate and should be replaced when their output is no longer sufficient to produce the amount of illumination decided upon for various places in the school building.

The school yard and playground should offer facilities for healthful, safe recreation and physical activities. Periodic inspection should be made of equipment used and any sharp-pointed or other dangerous objects should be removed.

Correct Equipment for School Eye Health

The second objective of a school eye health program is to provide equipment that will make possible a program of eye health, efficiency, and safety.

Seats and desks should be adjustable and movable and should be of a size and type that will provide for good posture. Desk tops that lift to an angle and are adjustable for distance are a great help in obtaining the best position of material in relation to eye use. Desks, tables, and chairs should be so arranged that no child faces the light or sits with his own shadow falling upon his work. If seats and desks are turned at a 30-degree angle away from the windows, the pupil will be spared glare from the sky.

Left-handed children should be so placed that the light will come over their right shoulder.

Workshops and laboratories should have protective devices on machines. Each pupil should be provided with goggles fitted to his needs; instructions should be given for their use and care, and provisions made for any necessary repairs.

Special attention should be given to printed and duplicated materials; these should meet the requirements of legibility that make for ease and comfort in seeing: clear type in black ink, on dull-finished white or light cream paper, with adequate spacing be-

tween words and lines, and adequate margins.* The size of type should be determined by the needs of the children. Young children require larger type than older pupils. For those under seven years of age, 24- to 30-point† type is recommended; for older children, a gradually decreasing size so that a pupil twelve years of age or over will have a 10-point type.

Chalkboards of slate, glass or composition material should be installed and be kept in condition. A chalk should be selected that will make heavy, clear lines, in a color that will give the greatest contrast. With slate, gray-green or blue-green boards, white chalk is preferable; with buff-colored boards, a dark blue.

Responsibility of School Personnel for Eye Health

The third objective of a school eye health program is to develop in all members of the school staff the desire and ability to accept their share of responsibility for the care and protection of the eyes of their pupils and of their own eyes.

A comprehensive school eye program must include every aspect of the school activity. In order to make such a program effective, each member of the school staff must participate. Administrators are responsible for providing correct physical and educational equipment. It is the responsibility of the teacher, with the supervision of the administrator, to see that everything so provided is used to the best advantage. In order to fulfill this obligation, every teacher should be familiar with the normal growth and development of the eye and the possible effect of any deviations from the normal on the health, education, and personality of the child. She must know how the normal eye functions to perceive the form of objects in the direct line of vision; how it adjusts for clear vision at various distances; the part that peripheral vision plays in giving an awareness of objects in the field of view; the importance of binocular vision in enabling the individual to judge distances and perceive three-dimensional form; and the significance of color vision and of the process of adaptation of the eyes to varying degrees of light.

* Luckiesh, Matthew, and Frank K. Moss, *Reading as a Visual Task*, New York. D. Van Nostrand Co., Inc., 1942. Chapters V–IX.

† Point: the unit of measurement of type size; there are 72 points to the inch.

She should learn to observe (and possibly to test) the individual child, to detect any indication that he may have limitations in any of these functions. She must also know which of the various visual functions are brought into play in each task or activity, and how a defect in any function may affect the child's ability to perform tasks expected of him. She can use to good advantage knowledge of how defects can be corrected or compensated for. Without such knowledge it is impossible for the teacher to appreciate the necessity of adapting educational procedures and materials to individual needs, and of arranging class activities so that no periods of work requiring close use of the eyes will directly follow one another; or to guide the child with uncorrectible visual defects into vocations in which his limitations will not prove a handicap or a hazard.

The teacher who has adequate knowledge of how the eyes function, an appreciation of the effect of visual defects or general health status of the child, and an understanding of the influence of illumination and other environmental factors, will be well equipped to impart the basic principles of eye health education to her pupils. Moreover, she will readily appreciate the importance of putting these into practice in school activities and of teaching the child to do likewise.

Children having serious eye difficulties will need special consideration.* Some school systems have established sight-saving classes for them, but where these are not available, special equipment should be provided and all work requiring close use of the eyes should be carried on in accordance with the recommendations of an eye physician.

Modern educational procedures depend largely on the use of sight. It is therefore necessary for all those concerned with the welfare of the child to know as early as possible what his eye condition is. Since eyes change with growth, periodic examinations are necessary throughout the school life. Ideally, every child should have a thorough medical examination, including an eye examination, before he enters school and at regular intervals thereafter. Since this is not always possible, various tests of visual functions are given by school physicians, nurses, or teachers. To be of value,

* Hathaway, Winifred, *Education and Health of the Partially Seeing Child*, New York, Columbia University Press. (In press.)

such tests must be correctly given and must be supplemented by observation on the part of the teacher of the reactions of the children during their daily activities.* The findings of such tests and observations should be interpreted to parents by the school health service in order that, where necessary, they may seek professional advice. The school health service also carries the major responsibility of assisting parents to secure such necessary advice and of helping them to follow any recommendations made. In order that the school health service may act intelligently, the department should be supplied with adequate records of medical examinations and of the recommendations made.† The most desirable results are obtained through the co-operation of the parents, the school health service, the teacher, the medical profession, and community agencies.

Community Co-operation in Solving Eye Health Problems of School Children

The fourth objective of a school eye health program is to interpret to the proper authorities and agencies eye health problems of the school in order that the best use may be made of what the community has to offer and that resources be made available if such do not exist.

Community agencies outside the school have responsibilities related to the eye health of school children that are not within the province of the school. The care of the eyes is a fundamental and an integral part of such a health program. Some eye difficulties are the result of venereal disease, tuberculosis, nutritional deficiency, or other general health difficulty, and prolonged treatment may be necessary. It is the responsibility of the school health service to help parents understand the need for this and to encourage continuance of treatment.

Sometimes when a child returns to school after a severe illness the physician recommends restriction of his physical activities. In cases in which the eyes have been affected, the restrictions

* Directions for giving vision tests and lists of observable behaviors may be obtained from the National Society for the Prevention of Blindness, 1790 Broadway, New York, N. Y.

† Sample record forms may be obtained from the National Society for the Prevention of Blindness.

may include a recommendation limiting the use of the eyes for close work. It becomes the school's responsibility to see that this recommendation is carried out. If a sight-saving class is available, the child may be placed in it as a temporary measure; in such a class he will have the advantage of a teacher prepared to understand his difficulties and to assist him in the best possible way. If a sight-saving class is not available, the school nurse or the school physician should interpret the needs of the child to the teacher of the regular grade.

Education of Parents and Children in Eye Health

The fifth objective of a school eye health program is to insure the ultimate goal of a school health program by educating parents and children to assume their responsibilities for eye health.

A health program should be continuous for the school life of the pupil. If the school authorities have fulfilled their obligation by providing a school building and school equipment best suited for eye health and efficiency, and if the teaching personnel has likewise fulfilled its obligation for making correct use of such provisions, the child, through his daily experiences, learns the principles of eye health, eye efficiency, and eye safety. But parental and community education must keep pace if results are to be accomplished. Since the social, economic, and psychological aspects of eye health and efficiency are as important as the educational, an understanding of these and an appreciation of their influence must be included in all programs planned for the child's welfare. Such appreciation and understanding may be engendered through visits of the parents to the school, discussion at parent-teacher meetings, and group and individual conferences with welfare organizations. Visits of the school personnel—nurses and teachers—to the home are important in developing confidence—confidence between the visitor and the parent, and between the parent and the school.

Opportunities for the Visually Handicapped Through Job Analysis*

Eileen Lester

SELECTING the job according to the capacity of the eyes is a somewhat new approach in industry, but a very practical one to apply, especially in seeking to increase manpower to meet war emergencies, according to Miss Lester.

THE military demands of war, with their grim realities, are rapidly emptying our great national reservoir of sound and sturdy men. What shall industries of all kinds do to get efficient replacements? That question has been presented to us for a reply and the answer is that if the employee is selected according to the requirements of the job, it does not matter whether he is physically impaired. How can this be done? By job analysis and by analysis of the qualifications of the employee. The abilities of the handicapped are gaining recognition because they are proving their worth.

Since the present discussion deals with the visually handicapped it is desirable to know what is meant by this term. The visually handicapped are those individuals who have limitations of a type or degree requiring careful selection of occupations to avoid those which are beyond their visual ability, or which might endanger their remaining sight, or which constitute an accident hazard to themselves or to their fellow workers. The group includes those individuals who have limited central visual acuity—by this is meant vision in the better eye after correction of between 20/200† and 20/70, making it difficult to recognize small details of form or

* Paper presented at the National Society for the Prevention of Blindness meeting at National Conference of Social Work, New York City, March 10, 1943.

† By 20/200 vision is meant that the individual sees at a 20-foot distance what the normal eye would see at a distance of 200 feet.

to work constantly under poor illumination. It also includes individuals with better than 20/70 vision but who have a pathological or progressive eye condition which may be made worse by certain types of activities or conditions of work.

It also includes a large group of individuals who have better than 20/70 central vision but who also have another limitation in visual function which constitutes a handicap or hazard in the performance of particular types of visual tasks. For example, an individual who has good distance vision but poor depth perception should not be allowed to operate a crane because that person would not have the ability to judge adequately the position of the objects viewed.

Although there are no accurate statistics regarding the total number of persons in this country who are visually handicapped, the few studies that have been done disclose a surprisingly high percentage of vision defects among the general population. A report made by the medical directors of college health services estimated that 15 to 25 per cent of the students entering colleges have serious visual defects. In the study of the health status of NYA youth, 20 per cent were found to need refraction. Of the first one million young men examined by Selective Service, 50,000 were rejected because of eye defects considered serious enough to limit their efficiency in modern warfare. Studies done by two industrial ophthalmologists reveal that among the average run of workers entering industry, one may expect to find approximately 15 per cent of them with serious vision defects which undoubtedly constitute a handicap to the individuals under certain conditions. A recent survey of 50 plants employing 167,000 workers found that 25 per cent of the employees have defective but correctible vision.

It is a common belief that modern industrial production depends on good vision but the problem is: "What is meant by good vision?" Many of the larger industrial concerns have made the Snellen visual acuity notation of 20/20 or 20/30 a prerequisite to pass the pre-employment vision examination and an individual failing to pass this eye test may be rejected from employment because of defective vision. Dr. Snell of Rochester pointed out in a paper* read at a meeting of the New York Society of Clinical Ophthalmology that

* Snell, Albert C., M.D., "The Need for a More Realistic Ophthalmic Service in Industry," *New York State Journal of Medicine*, Volume 42, No. 15, August 1, 1942.

an inflexible standard, acceptable for perception of visual acuteness, is often used in determining visual fitness for employment, but in the setting up of standards for all other physical functions, no such rigid, inflexible standard is used. All individuals do not possess an equal amount of physical strength, intelligence, or skill. It is a mistake to think of the process of seeing as a single function which can be evaluated by a single test. If we are going to evaluate the prospective employee's visual ability to perform a certain job, other visual functions in addition to acuity must be tested, because visual acuity for distance alone is not an adequate index of visual efficiency.

It is important that binocular vision, or the ability to use both eyes simultaneously to focus on the same object and to fuse the two images into a single image, be evaluated, since the individual uses this type of vision in many occupations. Another factor that is of vital importance in the performance of certain tasks is stereopsis, or the ability to judge distances. A one-eyed man lacks this ability and, in certain occupations, this might constitute a serious hazard to his fellow workmen. Another function that is of vital importance is muscle balance, or lack of it. Many young men who otherwise have been able to meet the high physical standards required of aviators have been eliminated because of this type of eye defect.

Another factor that should be considered before individuals are placed in jobs involving a high degree of color discrimination—as, for example, trainmen who must observe colored signals—is whether or not they are color-blind. In certain occupations peripheral vision or the ability to perceive objects in the area surrounding the direct line of vision is necessary and should be measured.

Dr. Kuhn, an ophthalmologist working in the industrial field, stresses the point that a modern program and technique of examining eyes in industry which is based on evaluating *visual acuity*, *depth perception*, *muscle balance*, and *color deficiency*, contributes a great advance in exactness of data regarding visual function.* The present routine of eye testing employed by most plants having a pre-employment vision examination, fails to disclose whether an

* Kuhn, Hedwig, M.D., "A New Concept of Visual Performance in Industry," THE SIGHT-SAVING REVIEW, Volume 10, No. 4, December, 1940.

individual possesses the visual qualifications necessary for the particular job to which he hopes to be assigned if employed.

All occupations do not require the same degree of visual function, and the important thing is to place the workman in a job which takes into consideration his visual ability. Job analysis is the most successful method through which detailed information about an occupation can be attained. It is used in industry to furnish employment departments with accurate data concerning the requirements of the job and the qualifications which the worker must possess to perform the job successfully. The analysis must outline the nature of the job, the exact duties to be performed, the mental and physical effort—including the degree and type of visual ability necessary to do the work—essential skills, and the working conditions involved in the job. It also covers hazards, wage scale, promotional opportunities, and any other factor that has a bearing upon the worker's ability to perform satisfactorily the duties of the job.

It is an encouraging sign that a few war industries have had job analyses made and, as a result, have created new opportunities for visually handicapped individuals who possess the qualifications considered essential for the job to be performed. Many of these new job opportunities require relatively simple types of training and when the visual abilities of the individual match the visual requirements of the job, a successful placement of the visually handicapped person will result, provided all other factors have been adequately considered.

The Occupational Analysis Section of the United States Employment Service has analyzed more than 70,000 jobs in war industries and the armed forces. Can't we hope that this agency will continue its contribution in the field of job analysis during the peacetime reconstruction period? Several examples of job analysis may help to demonstrate what is meant by selecting the worker for the job. Dr. Kuhn describes two employment situations in which certain visual qualifications are essential if the work is to be satisfactorily performed. For example, the overhead crane operator may have to drop a load of molten steel on an exact spot at an exact moment, 150 feet from where he pulls the levers. To do this with safety and efficiency, he has to have depth perception as well as good

central vision in each eye, and he cannot have a major defect of muscle balance. At the other extreme is a girl at a looping machine in a hosiery mill where her work has to be set a distance of 8 inches from her eyes. She must have perfect binocular co-ordination and ocular balance to sustain a sharp focus for an eight-hour working day. It is evident that neither of these jobs could be done by a person with a serious visual impairment. On the other hand, job analyses have shown that individuals working as unskilled outdoor laborers can often perform their tasks successfully even if they have vision as low as 20/100.

Other visually handicapped individuals have demonstrated their ability to be employed successfully as inspectors when their work involves the use of mechanical gauges or assorters, and as certain types of machinists, metalsmiths, and mechanics.

The following case illustration may be of interest:

A 20-year-old man was referred to the medical social worker in an eye clinic. The social worker learned that he was one of six boys; the other five were eligible for the draft or were working in defense plants. The patient had been called for selective service but was deferred because of his vision. His right eye was crossed and he had no vision in this eye because of long disuse. The young man wanted to aid the war effort and had applied for employment at a certain shipyard, but had not heard from the personnel office; and he felt certain that they did not want to hire him because of his eye condition. Surgery for cosmetic improvement was advised and after two operations the crossed eye was straightened and his appearance greatly improved. He again applied for employment at this same shipyard and although he had only light perception in his right eye (vision in his left eye was normal) he was placed successfully in a job which required certain skills that he possessed but which did not require binocular vision.

The value of the job analysis cannot be questioned. However, too few industries have done adequate analyses of the operations carried out within their plants and, as a result, do not know the visual requirements for certain jobs. The National Society for the Prevention of Blindness reports* in a survey which it made of 50 front rank industrial concerns, that more than 75 per cent of these plants make no effort to determine what visual requirements

* Tolman, Charles P., "Industrial Eye Efficiency in the War Program," THE SIGHT-SAVING REVIEW, Volume XII, No. 4, December, 1942.

are necessary or acceptable to qualify a worker for any particular job. The report goes on to say that this means "that these plants do not know how many color-blind or one-eyed men, or men with subnormal but correctible vision can be utilized." On the other hand, they may be employing men whose vision is a hazard on the particular job. Of these plants, 70 per cent make no test of the employee's vision; or if a test is made, it is inadequate to determine the essential factors of industrial vision.

Of equal importance—to quote further from the study—"The items related to industrial eyesight show that a relatively small number of the plants carry out adequate programs for saving sight. A still smaller number appear to understand or to follow those practices which would conserve sight and at the same time improve production, reduce spoilage, and regain skilled services from workers who have become handicapped by subnormal vision."

The evaluation of visual ability is primarily the responsibility of the ophthalmologist and it is important that he be consulted during the process of the job analysis and that he help to determine the visual requirements of the job.

Before placement of a visually handicapped individual can be considered, one must know not only how much, but what type of, vision the individual possesses, and how he or she can best use this vision with the minimum possibility of further loss. One of the principal difficulties facing the medical social worker, the vocational guidance and rehabilitation worker, or the placement agent, is the fact that although frequently an excellent medical report concerning the amount of vision, the eye diagnosis, and indicated treatment, is available, the report does not disclose what the individual can safely do with the amount and type of vision he or she possesses, and what working conditions, if any, should be avoided.

I wonder if we should not carefully review all the blanks that we use to obtain medical information in order to ascertain whether or not we make ourselves clear regarding what we must know about the individual's ability to do certain types of work, what things he can safely do, and what conditions of work would possibly jeopardize his eye condition and result in further loss of visual function. Too often, we merely put the full responsibility on the examining ophthalmologist and ask him to tell us what type of work

the individual should not do. Occasionally we receive the reply, "man able to do any type of work he can do with his remaining vision."

Ophthalmologists cannot always be expected to know the visual requirements of all the various occupations. This is also the responsibility of the social worker who is trying to help the visually handicapped person find suitable employment. We should be able to assist the doctor in his evaluation of the individual's visual ability by asking specific questions concerning certain activities or conditions of work which might be contraindicated. For example, we might include in our medical referral form such questions as whether it would be permissible for this particular man or woman to do work requiring the constant lifting of heavy objects, fine discrimination of detail, color perception, or work which must be done under either brilliant or poor illumination.

In closing, may I repeat three essential requirements that must be considered if we hope to utilize successfully individuals with varying types and degrees of vision? These are:

1. A careful analysis of the applicant's qualifications with particular attention being given to his assets, liabilities, and attitudes that will influence any job placement.
2. The visual and other requirements of various jobs—information which will be available only as a result of job analyses.
3. The actual placement of the individual solely on the basis of his qualifications.

Conservation of Sight*

C. Edith Kerby

THIS article presents the facts and factors in the prevention of blindness program, discussing prevalence and causes of blindness, measures for preventing blindness, and agencies and personnel concerned with the problem.

THE objective of a program for sight conservation is prevention of all types and degrees of visual handicap, as contrasted with the objective of the program for social treatment of the blind. The programs overlap, in certain areas, but without duplication; however, in many respects they are quite independent but co-ordinated instead with other related fields. For example, one aspect of the prevention program involves integration of eye protection services into the general programs of public health. The program in each field of activity requires the services of many types of professional workers.

Definitions of Blindness and Seriously Defective Vision

For practical purposes the term "blindness" is usually interpreted to refer to "economic blindness," which includes not only total absence of sight, but sufficient visual handicap to require reliance on the other senses for the ordinary activities of life. The definition most commonly accepted defines a blind person as one who, with eyeglass correction, has central visual acuity of 20/200 or less in the better eye, or one who has better than 20/200 central vision, but an equivalent handicap due to limitation of peripheral vision (usually to a diameter of 20° or less). This means that the person on the borderline of blindness can just recognize at a given distance detail

* Excerpted, with permission, from the article, "Blindness and Conservation of Sight," written jointly with Evelyn C. McKay, and published in the *Social Work Year Book, 1943.*

which a person with normal vision can see at ten times that distance. If the defect is in peripheral vision, his entire field of vision in the better eye would be less than the size of an ordinary book page at reading distance, and not much larger than the height of a tall man at a distance of 20 feet.

In addition, there is another important group of visually handicapped persons who are not blind, but partially seeing, which includes those having corrected visual acuity between 20/200 and 20/70, as well as those with less marked defects whose vision may grow progressively worse. Such persons carry on as sighted persons. Their chief needs are safeguards to conserve the remaining vision, and selection of educational media and vocations suited to the nature and degree of the individual handicap.

Prevalence of Blindness and Defective Vision

Existing census data on the number of the blind are incomplete and out of date. The best estimates available place the figure for the number of blind (as defined above) in the United States somewhere between 200,000 and 250,000, or approximately 1.5 to 2.0 per 1,000 of the general population. The number of partially seeing is probably higher. It has been found to be about 2 per 1,000 in the school-age group.

Moderate or slight degrees of deviation from normal vision are quite common in the population at all ages and all economic levels. Estimates of their prevalence by type and by degree are impractical, because experts find it difficult to define a "defect," inasmuch as the need for correction depends so largely upon the individual's tolerance of a minor defect.

Causes of Blindness

Study of the causes of blindness of our present blind population serves two purposes: It gives information regarding the nature, degree and underlying cause of blindness which is necessary in planning corrective medical care for the individual, if this is still possible, and provides data basic in development of adequate preventive services.

Having developed a Standard Classification of Causes of Blind-

ness,* the Committee on Statistics of the Blind inaugurated in 1933 a series of studies in which data are presented in cross-classification to show both the etiological factors and the type and site of eye affections. Information available to date covers approximately three-fourths of the blind of school age and a group of 20,000 adults in fifteen states and the Territory of Hawaii. Moreover, the Social Security Board is preparing for publication the results of a study of eye examination records in twenty of the states administering aid to the needy blind. This report, in which the Standard Classification of Causes of Blindness was used, should make a valuable contribution to our knowledge of causes of blindness of the adult blind. While these samples are not representative of the entire blind population, analysis of the findings of these studies indicates where emphasis must be placed.

A wide variety of etiological factors is responsible for existing blindness, the most important of which are communicable diseases, trauma, certain general systemic and deficiency diseases, hereditary and other prenatal factors, neoplasms and poisonings.

Information regarding etiological factors is lacking in a very large proportion of the total cases studied. These include types of affections, such as senile cataract, glaucoma and myopia, concerning which there is need for further medical research; also a large number of individual cases in which satisfactory study of the etiology either was not or could not be made.

The data on causes of blindness in children are more complete. Blindness in this age group, as shown in the reports of the Committee on Statistics of the Blind,† is due to communicable diseases, 24 per cent (chiefly ophthalmia neonatorum, 11 per cent; syphilis, 5 per cent; meningitis, 2 per cent); heredity, 13 per cent; prenatal factors the nature of which are unknown, 38 per cent; accidents, 8 per cent; neoplasms, 3 per cent; general diseases, 2 per cent; unknown, 12 per cent.

In early adult life, the causes are: communicable diseases (syphilis is responsible for about half of the cases; the trachoma rate, while very high in some states, is probably well under 5 per cent

* See "Manual on the Use of the Standard Classification of Causes of Blindness," Committee on Statistics of the Blind, 1940 (*infra cit.*).

† See "Eye Conditions Among Pupils in Schools for the Blind in the United States 1939–40" (*infra cit.*).

for the country as a whole); accidents, occupational and non-occupational; some early cataract and glaucoma of unknown etiology; and a small percentage of blindness due to poisonings, neoplasms, general diseases, and hereditary factors.

In mid-life, senile cataract, glaucoma, and general diseases (especially diabetes and vascular diseases) account for an increasing proportion of blindness. The total percentage due to communicable diseases is reduced slightly, except for syphilis, which remains high, and trachoma in affected areas. The incidence of trauma is much less than in younger age groups.

In old age, the cases of unknown etiology head the list, cataract probably accounting for about half the cases of blindness in this age group while the glaucoma rate, which remains the same as in middle life, is still important. Blindness due to general diseases (particularly vascular diseases) increases, while the proportion due to communicable diseases is reduced.

Special studies show that causes of eye difficulty among the partially seeing are similar in nature but somewhat different in distribution. In addition, there are many cases of refractive errors, chiefly high myopia, which cannot be corrected to normal with glasses or which are progressive in nature.

Prevention of Blindness

Mere listing of the underlying causes of blindness proves that the problems of prevention are manifold and that their solution involves a variety of methods and the co-operative efforts of many agencies and professional groups. Among the more important facilities and measures that might be mentioned are the following:

1. Measures for the control of communicable diseases are in the province of the health officer and his staff of public health nurses, laboratory technicians and others. Just as health authorities deserve the credit for reducing the incidence of blindness from smallpox almost to the vanishing point, so we are relying heavily on them to prevent blindness from the venereal diseases—syphilis and gonorrhea—by case finding, treatment and educational services and to publicize the efficacy of the new sulfa drugs in the prevention of blindness from trachoma and ophthalmia neonatorum.

2. Specifications for safety devices and the program for safety education to prevent injuries to the eyes are primarily the responsibility of safety engineers in industry and elsewhere. However, it is essential that they acquire some specialized knowledge of hazards to the eye.

3. For investigation of hereditary factors in blindness (both the general patterns of heredity and the facts concerning a particular family situation) the services of the geneticist may be required, but the application of this knowledge will usually depend upon a physician or social worker who has gained the confidence of individuals in the affected families.

4. All measures aimed at maintenance of general health and nutrition at a high level contribute to prevention of blindness and conservation of vision. Hence, the importance of health education programs, whether in official or voluntary agencies, cannot be stressed too much.

5. Inclusion in preventive health examinations of adequate techniques for the detection of eye defects and of follow-up to secure corrections is recognized as essential in the service required for all age groups. Whether this service shall be offered by the department or agency having primary responsibility for the group, or by another department through co-operative arrangements (as in the case of health department services within the schools), is immaterial, provided the plan is adequate and does not involve duplication of services.

6. For the complete examination and medical or surgical treatment required by individuals with eye conditions which might lead to blindness, ophthalmological service is needed. This may be provided in the eye service of a hospital outpatient department, or in the private offices of ophthalmologists. Whether paid for by the individual or an interested agency, it is important that the service be available within reasonable limits of space and time.

7. Measures which aim at the adjustment of general environment or visual tasks for greater comfort and efficiency in seeing are desirable. Notable examples of these are standards for adequate lighting in schools and industry, and special classes for education of the partially seeing school child (in which, by the use of ideal lighting, large-type books, reduced eye work, etc., education of the child is suited to his needs).

8. Legislation is a powerful weapon,* whether it makes mandatory desirable protective procedures (such as use of

* See "Mobilization of State Forces for Prevention of Blindness" (*infra cit.*).

prophylactics for ophthalmia neonatorum, premarital and prenatal examinations for venereal diseases, safety specifications), or authorizes establishment of necessary services in appropriate official agencies (for example, ophthalmological examinations and corrective treatment for those threatened with blindness, special educational facilities for the partially seeing).

Prevention of Blindness Agencies and Personnel

As we have seen, the various aspects of prevention of blindness can be effectively integrated into broad general programs of health, welfare, safety and education. However, there is need for a prevention of blindness agency as such, whose function is to stimulate and co-ordinate the activities of the various official departments and voluntary organizations. In a given state or community this may be the responsibility of either an official or a voluntary unit. Since the two types of agency function somewhat differently, there is a place for both, even within the same area, provided they co-operate rather than compete. Ordinarily the official bureau charged with responsibility for prevention of blindness will have its powers and duties limited by the legislation or budget under which it operates. Thus it is left to the private agency to discover additional needs, to demonstrate the value of new services, and to develop public opinion in support of all services.

Administrative responsibility for leadership in the state programs for prevention of blindness is delegated by law to official departments in forty states, although a few have only limited responsibility. Actually only 15 states have established programs under existing legislation. Some of these have budgetary, personnel, or organizational limitations. In addition there are four voluntary state agencies for prevention of blindness, as well as several effective local agencies. The chief national organization operating in this field is the National Society for the Prevention of Blindness, a voluntary agency. Several federal departments (for example, the United States Public Health Service and the Social Security Board) and voluntary national agencies, such as the National Safety Council, co-operate with the National Society in certain phases of the program.

The aim of the National Society for the Prevention of Blindness

is to give guidance to all types of agencies in any phase of the prevention program. Through its research, library and field services it endeavors to keep informed on the nature and extent of the problems and new developments in their solution. It stimulates public opinion in support of needed legislation and facilities. It helps to establish courses for the preparation of prevention of blindness workers (as in the training of sight-saving class teachers and supervisors, of medical social workers in eye services of hospitals, of directors in community programs for prevention of blindness, of health educators, and of public health nurses). Through educational materials, such as periodicals, pamphlets, films, exhibits, and vision-testing charts, as well as through advisory service and correspondence, it shares its knowledge of methods of conserving sight and preventing blindness with leaders in this field and with the general public.

Current Tendencies and the Effect of the War

There has been a marked growth in all types of organized activity in the field of prevention of blindness during the past few years, due in part to needs brought out by the Aid-to-Needy-Blind program of the Social Security Board, and in part to growing public appreciation of advantages and possibilities of prevention in all health matters. This tendency is intensified by the demands of the war situation for maximum manpower. Unfortunately, the war situation also tends to draw out of this field many trained workers and new workers who might otherwise seek special training for the service, and this is occurring just at a time when hazards to the eye are potentially greater. For example, safety workers are having to provide equipment and teach eye safety to millions of workers in new industries or processes under the handicap of tremendous speed-up. Similarly, public health authorities are hampered in controlling venereal diseases and trachoma by large-scale movements and concentrations of the population. On the other hand, because the war situation aggravates the problems, it may also highlight the need and give prevention of blindness a greater place in the war-time and post-war plans.

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The Forum

THIS section is reserved for brief or informal papers, discussions, questions and answers, and occasional pertinent quotations from other publications. We offer to publish letters or excerpts of general interest, assuming no responsibility for the opinions expressed therein. Individual questions are turned over to consultants in the particular field. Every communication must contain the writer's name and address, but these are omitted on request.

"Time Marches On" in Sight-Saving Classes

Do you find that occasionally some incident of your childhood, trivial perhaps in itself, has made such an impression upon you that it frequently bobs up before you? One picture of my school days frequently comes to mind. It is etched clearly on memory's page. I see the schoolroom, a rather large one with windows on two sides, equipped with old-fashioned wooden shutters —dirty, dingy walls, no artificial light. Desks were nailed down to the floor. They were not adjustable to size. If you were too small, your feet dangled. If you were too tall, your feet reached up under the desk of the pupil three seats ahead. Into this picture, in the midst of children most of whom were 11 and 12 years of age, steps a girl of 16, taller than the teacher, shy, always blushing over her conspicuousness, wearing very thick glasses, and stooping from constantly peering at things she can't see.

Kate always had to be in the front of the room, looking at the teacher's notebook. With this pressed against her nose she was able to read a little. The teacher was kind and had infinite patience. Doubtless we were not so kind and thoughtful—no better than countless generations of other children. I am sure we said and did plenty of things which hurt her cruelly. Before the end of the year, Kate became discouraged and left school, compelled to conclude her education at fifth-grade level. All the rest of us saw things quickly. Her mind was all right, but her eyes took lots of time for every single picture printed on the retina of her eye. Education moved along too fast. The struggle was too great. She had to quit, much as she wanted to go on. The title of this might be like the popular cartoon, "Born Thirty Years Too Soon."

So, in the words of the radio, "Time marches on." My next meeting with Kate was years later

when sight-saving classes were in the infancy of their development. The first sight-saving class in that community was being organized. One of the children to enter that class was Kate's first born, a girl six years old, born blind with cataracts. Medical science stepped in. The child had five operations before she was six years old and, with the aid of glasses, she was able to enter school—not to attend regular classes, but a sight-saving class.

The room was a large, pleasant classroom. The walls were painted a cheerful, light-reflecting cream color, with a matte surface. Strangely enough, this room was in the same building that provided the locale for the first picture I gave you. The desks were an innovation, at that time movable, so that children who could not see the blackboard well, could move their desks into any position that they wished. The books were printed in bold, black, 24-point type letters, upon dull cream paper. All the writing was large, with heavy, thick lines.

The room was artificially lighted by four outlets with totally indirect fixtures, each containing a 500-watt bulb. We had at that time what was considered an amazing amount of light—12 to 15 foot-candles on the work surface. The electrician who installed the lighting made the astounding statement that the teacher would be blind within a year. He was a poor prophet.

Kate's child graduated from high school two or three years ago. She finished at the normal age. Throughout her school life she did her written work in the sight-saving class, under the best conditions possible at that time, and under the intelligent care of a teacher trained in eye hygiene. All of her oral work was done in the regular classes with the so-called normal group. She had a good mind, but no better than her mother's. But her mother, having been born some years too soon, endured frustration and disappointment which her children have in a large measure been spared.

K[illegible] has had five children, three [illegible] eye difficulty that she had. [illegible] of these children have been in sight-saving classes. They all moved along at a normal rate of promotion; the youngest is still enrolled. Those interested in eugenics can see many implications in this case, which I will leave to them. Time still marches on.

Some of our newest sight-saving classes have many improvements in equipment not possible for Kate's oldest child. Her youngest, however, may benefit by what additional knowledge time has given medical authorities, educators, psychologists, and psychiatrists, in helping her child to make a better adjustment and to keep a healthy mind in a healthy body. Last, but not least, her child may work under from 25 to 50 foot-candles of well-diffused artificial light—light which does not depend upon the illumi-

nating level becoming low enough to force itself upon the notice of a very busy teacher. The amount of light is automatically controlled. Kate's youngest may also benefit from other refinements of equipment and teaching technique.

When a child is placed in a sight-saving class, the problem is to educate him with the least possible eye- and nerve-strain, to teach him enough eye hygiene to enable him to care for his eyes properly, and to provide such vocational guidance as will be of assistance in choosing occupations which will not be injurious to his eyes.

There are, in general, two types of sight-saving classes in this country. First, the segregated type, which places partially seeing pupils in special rooms where they carry on their activities. Second, the co-operative type, which originated in Cleveland and is the most widely used throughout the country. This plan places the partially seeing child in a special room for work requiring the use of the eyes. For all other work, he joins the pupils of the regular grades.

The child spends part of the time in a regular classroom and part in the sight-saving classroom. The sight-saving classroom is his home-room. All work requiring the use of the eyes is done in the room especially equipped for him, and under the direction of the sight-saving class teacher, who knows the habits of eye use each child must form, and how much and what kind of eye work the eye physician has recommended for each child.

Oral work in which he may listen and participate is carried on in the regular grades. Thus he competes educationally and socially with the normally seeing group in his community, and learns to measure his own achievements in relation to those of others of his own group. This helps to prepare him for his later vocational life when he must have his work judged on the same basis as his fellow worker with normal sight.

It is also a distinct advantage to have covered the same day-to-day assignments as those in the regular grades in case the child's vision improves enough to return him to regular grade. The transfer may be made easily with a minimum of adjustment on his part. Thus, when a child with an eye defect is referred to a sight-saving class, as has been well said, "It is a room which has a door opening both ways," into a special class equipped with material to help him succeed educationally, and also into a regular class where he may evaluate his work in comparison with a larger group, and he continues as a part of the regular school group.

A classroom of standard size is selected which meets certain requirements as to floor space, window space, source of natural light, etc., as set up by the state department of education. The walls are

painted very light buff, and the ceilings, light cream. All painted or varnished surfaces are finished in a matte surface, to eliminate glare. The pupils' desks are movable and adjustable; the tops tilt and are adjustable for angle; and, in the newer desks, the tops are adjustable also for distance. This is a valuable aid in securing improved posture.

Large-type books printed in 24-point type, large maps, unglazed paper, large pencils and soft white chalk are some of the pupils' special tools. According to the grades represented in the room, it may be equipped with sand-tables, easels, typewriters with bulletin type, and special copyholders.

Sight-saving class pupils follow the curriculum of the school in which they are located. In the primary grades, since reading is a basic subject and must be gained from special books, the sight-saving class teacher is responsible for the teaching of all reading, spelling, writing, arithmetic, and eye hygiene.

In addition to the work done in the regular grade, sight-saving class pupils are taught the touch system of typing as a sight-saving aid. This has proved very helpful to students in senior high school and college.

Additional training in handwork and music is given. Eurythmics is found to give valuable contribution to the training of the child with defective sight who is shy, diffident, awkward, and has poor motor coordination. Handwork furnishes a period of eye rest from close work, such as reading, and develops skills and ideas which may be useful in making articles at home as a leisure-time occupation.

Radio lessons are proving a distinct educational aid for sight-saving class pupils, since the major emphasis is on learning through the ear.

"Time marches on!" Perhaps many years later Kate's youngest child may feel that he was "born thirty years too soon," for perhaps the world will have found more ways of preventing the occurrence of eye difficulties among children. To the hastening of that time all of us, educators, the medical profession, engineering groups, and the whole scientific world should dedicate our best efforts.

—OLIVE S. PECK

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Ask Me Another—Sight Conservation*

Fill in each blank to make a true statement. Turn to page 54 to check your answers.

1. A medical practitioner who specializes in treating eye diseases and defects is known as an ..... or an .....

* Prepared by Eleanor W. Mumford, R.N., Associate for Nursing Activities, National Society for the Prevention of Blindness, and reprinted with permission from the *American Journal of Nursing*, April, 1943.

2. A non-medical practitioner who treats refractive errors and muscle defects without the aid of surgery or drugs is known as an .....

3. A person who grinds lenses, fits them into frames, and adjusts the frames to the wearer is known as an .....

4. Visual acuity of ..... is considered normal.

5. Accommodation is relaxed when the normal eye is fixed on an object at a distance of ..... feet or more.

6. Interstitial keratitis is an inflammatory disease of the cornea usually due to ....

7. An opacity of the crystalline lens is called a .....

8. The prophylactic solution considered most effective in the prevention of ophthalmia neonatorum is .....

Indicate by its letter which of the words or phrases following each sentence should be used to complete the sentence correctly.

9. Ophthalmia neonatorum is..... caused by a gonococcal infection.

(*a*) sometimes; (*b*) always.

10. About ..... per cent of the children in schools and classes for the blind are born blind.

(*a*) 10; (*b*) 90; (*c*) 40.

11. Light should be directed over the shoulder ..... the hand that is used.

(*a*) on the same side as; (*b*) opposite.

12. In childhood, ... is considered normal.

(*a*) myopia; (*b*) emmetropia; (*c*) hyperopia.

13. Patients with measles should .....

(*a*) have their *eyes* protected from bright lights; (*b*) be kept in a dark room.

14. Children.....outgrow crossed eyes.

(*a*) usually; (*b*) seldom.

15. In glaucoma, central vision ..... remains good until the disease is well advanced.

(*a*) seldom; (*b*) often.

16. Blindness from glaucoma can ..... be prevented through early treatment and prolonged follow-up.

(*a*) often; (*b*) rarely.

17. Without good co-ordination of the two eyes, ... is usually faulty.

(*a*) color vision; (*b*) visual acuity; (*c*) depth perception.

18. The term "farsightedness" is used to indicate a condition in which .....

(*a*) one sees a greater distance than is normal; (*b*) one sees distant objects with less effort than is required for near vision.

19. Sympathetic ophthalmia is a disease which endangers the sight of the .....

(*a*) injured eye; (*b*) uninjured eye.

20. Convalescent patients should ..... encouraged to use their eyes for long periods of close work.

(*a*) not be; (*b*) be.

21. It is important to secure early ophthalmological treatment of strabismus to ..... and to .....

(*a*) prevent psychological difficulties; (*b*) prevent the necessity of wearing glasses; (*c*) save the sight of the non-fixing eye.

22. In the following list of symptoms and conditions, check those which indicate the need of *immediate* ophthalmological care:

1. Sudden decrease of vision
2. Watery eyes
3. Seeing more than one image
4. Halos around lights
5. Headaches
6. Changes in ability to distinguish colors
7. Sharp pain in the eyes
8. Appearance of dark areas in the normal field of vision
9. Itching lids
10. In children habitually holding book or similar visual material abnormally close to eyes
11. A foreign body embedded in the cornea
12. Burning sensation of the eyes
13. Twitching of the lids
14. Purulent discharge from the eyes
15. Hemorrhage in the bulbar conjunctiva
16. An injury which penetrates the globe
17. Styes

Eye Injuries in Childhood from Blasting Cap Accidents

Accidents to children from playing with blasting caps, many of which result in the loss of one or both eyes or impairment of vision, will be made the subject again this year of a vigorous campaign of education, in the hope of completely eliminating these tragedies. In the year 1942 there were 117 blasting cap accidents, involving 145 children. Of the children hurt, 36 lost the sight of one eye or both eyes, or their eyes were injured. These children ranged in age from five and six years to fifteen and sixteen.

The high percentage of eye injuries is due to the nature of a blasting cap explosion. The caps are small metal cylinders about one-quarter inch in diameter, and an inch or two long, closed at one end and loaded with a charge of sensitive and powerful explosive that is set off by a spark from a lighted fuse. Electric blasting caps have wires attached. These blasting caps are detonators used in firing high explosives and, as such, are vitally necessary in many types of work, including mining of all kinds, quarrying, road building, construction work, stump and ditch blasting, and other activities.

When these caps are exploded by children, they hurl fragments of metal in all directions and it is almost impossible for the boys and girls to escape injury. In addition,

the manner in which caps are tampered with leads to eye accidents. When children find them, their practice in a great many cases is to throw them into bonfires or try to light them with a match. The next most frequent cause of explosion is hammering them. Many of the children pick at the caps with a pin, knife, or nail. With the exception of when they throw the caps into bonfires, the children have the caps, in many instances, either in their hands or directly beneath their faces and, as a consequence, the pieces of metal hurled in all directions only too often find a target in the eyes. The list of such eye injuries is a long one and would fill pages. Some typical cases are cited below:

In Greenville, South Carolina, a fourteen-year-old girl had a blasting cap in her hands when it exploded. Flying fragments struck her in the eye. Near Minneapolis a talented high-school boy, a musician, suffered eye injuries when he touched a match to a blasting cap. Near Knoxville, Tennessee, a five-year-old boy was hit in the eye by flying fragments when his nine-year-old brother hit a cap with a piece of marble. At Post Falls, Idaho, the same story was repeated when a boy attempted to pry open a cap. An eleven-year-old boy at Flat River, Missouri, received fragments in both eyes as he hammered one with a rock. A five-year-old boy at Oxford, Ohio, found a blasting cap in the yard of his home where drilling had been done for a well. When it exploded, it so severely injured his right eye that it was necessary to have the eye removed. The other eye was also injured. One of the caps exploded almost in the face of an eleven-year-old boy at Park Ridge, New Jersey, threatening him with the loss of his left eye. At Greenwich, New York, a six-year-old boy lost his left eye when his elder brother struck a cap with a hammer. A five-year-old boy lost the sight of an eye in an accident at Arcadia, Wisconsin, when a playmate struck a blasting cap with a hammer.

In addition to the danger of blindness from such accidents, other types of injury received are especially painful and often render the victim incapable of useful work in later life. Fingers and sometimes hands are blown off, faces are disfigured, legs are mangled, and body injuries are also received.

The number of blasting cap accidents vary from year to year, but in recent years they have shown, on the whole, a decrease. In 1930 there were 327 children injured from playing with blasting caps. This number decreased to 292 in 1931. From then on, the statistics are as follows:

1932—171	children	injured
1933—198	"	"
1934—246	"	"
1935—235	"	"
1936—213	"	"
1937—165	"	"
1938—206	"	"
1939—195	"	"
1940—157	"	"
1941—132	"	"
1942—145	"	"

These figures are based on studies of newspaper and other clippings and on reports made by the Institute of Makers of Explosives.

About 68 per cent of the accidents noted take place in rural areas or in or near small towns. Large cities are comparatively free of them, although there have been cases where boys attending city schools have brought back blasting caps which they had found on week-end trips to the country.

The records of these accidents show that they begin to increase in the spring months and continue to mount until a peak is reached in July and August. After that, the number begins again to decline. This has been attributed to the fact that there is more open-air blasting during the spring and summer months and also to the fact that children play outdoors more frequently during these periods.

This is the seventeenth year of the educational campaign designed to prevent such accidents. Literature and posters warning against them, suitable for schools and other places, are issued by the Institute of Makers of Explosives, and are sent to any responsible persons on application. Schools in all parts of the country, government departments and bureaus, health organizations, safety societies, state mining and other divisions, automobile clubs, rural police, county agents, the National Society for the Prevention of Blindness, Boy and Girl Scouts, and other groups which have the welfare of children in their hands, are co-operating in the movement.

—F. J. BYRNE

Institute of Makers of Explosives, New York, N. Y.

Visual Acuity of College Students in Rocky Mountain State

The immediate importance of physical fitness in time of war serves to emphasize deviations from normal, particularly when they disqualify for military service. In the present war, visual defects rank high among the causes for rejection; for example, Rowntree[1] states that up to May 31, 1941, of 1,000,000 men rejected by the examining boards of Selective Service and the Army, 123,000 men were rejected because of eye defects. Only defects of the teeth ranked higher. Examination of University of Wyoming students has revealed an exceptional number with low visual acuity. In general, nearsightedness is probably the most common cause of low visual acuity in the college age group. Certain theories as to the etiology of nearsightedness held for a long time would lead one to expect comparatively little in a state such as Wyoming, where the population is sparse and use of the eyes for close work is not excessive. It is with the hope of stimulating further research into the causes of low visual acuity and possibly thus leading to prevention that the tabu-

lar data are presented in this discussion.

The Snellen test was given to the 1,549 entering students at the University of Wyoming (1939–1941). All of the students included are residents of the Rocky Mountain area, and most of them of the State of Wyoming. Examination of the table shows that 19.9 per cent of the men and 23.0 per cent of the women read finer print than the 20/20 line; of this number, a few read the 20/13 line, and one student, the 20/10 line. Of the remaining students, 32.7 per cent of the men, and 31.6 per cent of the women, had a visual acuity of 20/20; 47.4 per cent of the men and 45.4 per cent of the women had a visual acuity less than 20/20. If only the more severe defects are considered, 27.9 per cent of the entire group had a visual acuity of 20/50 or less, and 208 of these were disqualified for military service according to the original standard. The severe defect was bilateral in 63.5 per cent of those with a vision of 20/200 or less.

Statistics from many colleges are available. Two references are given for comparison. Kraehenbuehl[2] makes the general statement that approximately 31 per cent of the

VISUAL ACUITY OF 1,549 STUDENTS UPON ENTRANCE TO UNIVERSITY

Vision	*Men Without Glasses*		*Women Without Glasses*	
	Number	*Per Cent*	*Number*	*Per Cent*
$\frac{20}{15} - \frac{20}{10}$	157	19.9	175	23.0
$\frac{20}{20}$	258	32.7	240	31.6
$\frac{20}{30}$	171	21.6	58	7.7
$\frac{20}{40}$	24	3.0	33	4.3
$\frac{20}{50}$	30	3.8	39	5.2
$\frac{20}{70}$	28	3.5	54	7.1
$\frac{20}{100}$	30	3.8	44	5.8
$\frac{20}{200}$	70	8.9	59	7.8
Over $\frac{20}{200}$	22	2.8	57	7.5
Totals	790	100.0	759	100.0

youth of college age suffer from nearsightedness. Forty-six per cent of Wyoming students were unable to read the 20/20 line and are therefore potential sufferers. Boynton[3] reports a visual acuity of 20/50 or less in only 18.2 per cent of a group of 1,000 entering Minnesota students, as compared with 27.9 per cent of Wyoming students who had defects of this degree.

The causes of nearsightedness given in the literature are familiar. Close eye work has been considered an important factor by some authorities. Lindner[4] believes that close work, such as reading, which involves an intense metabolism of the retina, is the cause of trouble, rather than close work, such as watch repairing, where little movement is necessary. Certainly Wyoming youth are not given to excessive reading nor attendance at the movies, in comparison with other student groups. Both their work and recreation take them out of doors. If over-studiousness were general, inadequate lighting might be an important factor. Oil lamps are still used in many Wyoming homes. Of the 437 students questioned about it, over one-third had used them. As a matter of fact, defects were just as frequent in the group of students who had always used electric lights as in the other.

Eye defects are said to be more common among city dwellers.[5] There are approximately 2.3 persons per square mile in Wyoming and the population of the three largest towns is less than 20,000 each. Also fewer myopic eyes are said to be found at higher altitudes.[5] The altitudes in the most densely populated areas of Wyoming are between 5,000 and 9,000 feet; the lowest areas are between 3,000 and 4,000 feet.

Germans, Chinese, and Japanese are especially subject to myopia. Only about six per cent of Wyoming students have both parents of Japanese or German stock. Removing these from the group does not significantly alter the results. The accurate evaluation of heredity as a factor is impossible without actually contacting the parents. Students are too uncertain about details. All one can say after questioning them is that the wearing of glasses is somewhat more frequent among parents of those with defective vision.

Knapp[5] and others believe that disturbance in vitamin D-calcium-phosphorus metabolism is a cause of myopia. He reports improvement in myopic patients upon adding vitamin D and calcium to the diet. Wyoming differs from many states in these respects: It is a grazing state, fruits and vegetables are grown with difficulty, and there is a shortage of these foods in the average diet in comparison with agricultural areas. There is no reason for a shortage of meat and dairy products. General examination of Wyoming students reveals

little evidence of deficiency in any food element. Most of them are well built and in good physical condition. However, therapeutic trial of vitamin D and calcium might be profitable.

The causes usually given for nearsightedness, thus, are inadequate to explain its prevalence among these students. Myopia has been a frequent diagnosis in those who have had medical attention. Unfortunately, only 50 to 60 per cent have ever seen an ophthalmologist. The others have consulted optometrists or even travelling spectacle agents. The reasons are the scarcity of ophthalmologists in the state and the use of the title *doctor* by nonmedical men.

In summary, visual acuity tests on 1,549 University of Wyoming students by means of the use of the Snellen chart[5] reveals an exceptional number of cases of low visual acuity in comparison with other student groups. Ophthalmological examination is needed to determine whether myopic or other changes are responsible, and to discover whether altitude, diet, or other factors are bringing about these changes. Such a study might contribute much to the efficiency and happiness of large numbers of people.

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Laramie, Iowa

Answers to "Ask Me Another" Questions

The questions are on page 47

1. Ophthalmologist, oculist
2. Optometrist
3. Optician
4. 20/20
5. 20
6. Prenatal syphilis
7. Cataract
8. Silver nitrate
9. (*a*)
10. (*c*)
11. (*b*)
12. (*c*)
13. (*a*)
14. (*b*)
15. (*b*)
16. (*a*)
17. (*c*)
18. (*b*)
19. (*b*)
20. (*a*)
21. (*a*); (*c*)
22. (*1*); (*3*); (*4*); (*6*); (*7*); (*8*); (*11*); (*14*); (*16*)

Note and Comment

Summer Courses for Teachers and Supervisors of Sight-Saving Classes.—The National Society for the Prevention of Blindness has been notified that the following universities and colleges will offer summer courses for the preparation of supervisors, teachers, nurses, and others concerned with the education and health of partially seeing children. Elementary courses will be given at Wayne University, Detroit, Michigan, June 21–July 30—registration should be made two weeks in advance; at Michigan State Normal College, Ypsilanti, Michigan, June 21–July 30; and at Teachers College, Columbia University, New York, N. Y., July 6–August 13, registration July 1, 2, and 5. An advanced course will be given at Wayne University, Detroit, Michigan, June 21–July 30, for which registration should be made by June 7. For a complete announcement of the courses, apply to the universities.

Test Eliminates Soldiers Dangerous in Night Operations.—Many factors other than age can influence rate of dark adaptation and effectiveness of night vision, says Major B. W. Rycroft, Royal Army Medical Corps, but as a general rule soldiers over thirty years of age are found to achieve less efficient night vision than their younger fellows. Intelligence was one of the factors observed to influence the results of night vision tests. The more intelligent types of men—officers, men in headquarters companies—came through Major Rycroft's test with greater success than less well-educated and less responsible men. Defective day vision, especially myopia, corneal nebulae, familial defects, and other ocular diseases, produced under-average results. Unknown factors, which include possibly steamy goggles, fatigue, or malingering, were behind others of the failures.

The investigation, described in a recent issue of the *British Medical Journal*, was and is being carried out among troops in the British Isles. Upon completion of the testing of a unit, recommendations are made to unit commanders with a view to increasing the efficiency of night operations. The information submitted by

the examining physician consists of: (1) The general state of night vision in the unit as a whole and also in comparison with other similar units. (2) The names of personnel whose night vision is above average and who are especially fitted for night patrols, night leadership, night "spotters," etc. (3) Picked drivers whose night vision is above average and who may safely be trusted to lead a column of vehicles at night in total darkness without lights. (4) Drivers who are night-vision-defective and dangerous in their present military occupations. (5) An opinion on the general ophthalmic state, *e.g.*, what percentage should be sent for routine examination.

A portable test apparatus is used, which 10,000 cases have shown to fulfill the criteria of being simple, robust, and "productive of uniform and standard results." The apparatus consists of five translucent screens, arranged as an irregular pentagon around a small bulb. On each of the five screens is a large V, mounted in five different positions. The lamp in the center is at varying distances from each; and the whole apparatus can be rotated so as to bring one screen at a time in front of the patient. Two hundred men daily may be tested with this apparatus.

In one unit it was afterward found that two of the men who failed the test were drivers who had already had minor accidents at night. Major Rycroft adds: "Failures must be repeatedly tested before being condemned, and change of occupation recommended only when the soldier himself, having a lack of confidence at night, has failed on the test and holds a responsible position. It is not difficult as a rule to detect the malingerer: the test is completely new and unfamiliar to him."

Society Publishes News of Activities.—Early in 1943, the Society began publication of its *Eye Health & Safety News*, which will appear every few months. It is informal in presentation, containing items of interest on current prevention of blindness activities, and is planned especially to serve those working in some field of sight conservation. It contains items of interest hitherto appearing in the Society's two professional bulletins, *The Sight-Saving Class Exchange* and *Medical Social Workers in Eye Services News*, which have been discontinued in the interest of economy. Much of the material which appeared previously in the *Exchange* will also appear in the REVIEW or in *The Journal of Exceptional Children.*

Members and friends of the Society were asked to indicate whether they wish to receive the publication regularly, and hundreds of requests have already been received. After the next issue, the *News* will be sent automatically only to those who have sent in written word asking for it. REVIEW readers are invited to send in their requests and any news items of interest.

News of State Activities.—With the advent of the Society's *Eye Health & Safety News*, the REVIEW is discontinuing its section on News of State Activities; henceforth these items will appear, when reported, in the *News*.

Eye Health of NYA Youth.—A recent report of the health status of young people coming under the National Youth Administration contains an interesting analysis of the visual findings. In this study 146,562 young people ranging in age from 16 to 24 years were given Snellen tests. The group include both white and negro youths of both sexes. Color vision tests are reported for 144,538. The presence of external eye diseases or symptoms was noted in 7,685. This included 1,977 cases of strabismus.

Only the high lights of this report can be presented here. For detailed statistics the reader is referred to the original report.

Sixty-four per cent had a normal vision (20/20) in both eyes, while 86 per cent had at least 20/40 in the poorer eye; 7.8 per cent had 20/100 in at least one eye and 5.0 per cent had 20/200; 4.8 per cent had 20/70 or worse in both eyes, and 1.9 per cent had 20/200 or worse in both.

The percentage with less than 20/20 was somewhat lower in the negroes than in the whites, and they tended to have fewer serious defects. In both negro and white the percentage with less than 20/20 in the better eye was somewhat higher in females than in males. The northern regions revealed relatively more with defects than the southern. All visual acuity findings were made without glasses. Chart or general room lighting is not mentioned.

The color vision tests were made chiefly with the Holmgren yarn and the Ishihara. The latter was given to 31 per cent of the group and the former to 63 per cent, and 5 per cent were given both or some not specified test. The findings from the two tests varied markedly. The Ishihara revealed impaired color vision in 5.2 per

cent of white males while the yarn test showed only 1.5 per cent. In white females, Ishihara indicated defective color vision in 1.2 per cent and the Holmgren 0.2 per cent. The negro findings with Ishihara were 3.5 per cent of the males and 1.4 per cent of the females. Exclusive of one region where the results were so far out of keeping with other areas as to cast doubt on their reliability, the Holmgren indicated color impairment in 2.1 per cent of the male negroes and 0.9 per cent in the females.

Eye diseases or symptoms noted ranged from 4.3 per cent in the East South Central region to 7.1 per cent in the Pacific area. Northern and Western regions were higher than Southern, although New England was remarkably low. These conditions included blepharitis, conjunctivitis, strabismus, trachoma, pterygium and nystagmus. It is to be noted that no intraocular diseases are listed. Apparently no facilities were provided for discovering or diagnosing these conditions, although they undoubtedly are the cause of some of the cases of lowered visual acuity.

Eye Trouble Among Needleworkers.—When 3,300 corset workers (Local 32, International Ladies Garment Workers Union) were offered free eye examinations and eyeglasses, only 190 took advantage of the offer. Very few workers applied for examination unless they had worn eyeglasses previously or had some subjective symptoms of eye trouble. Of the group examined, 45 per cent wore glasses and of these no more than one-half had had their vision tested within the past three years. Only 27 per cent of the last group had lenses which gave adequate correction. Myopia, hyperopia, astigmatism, presbyopia, conjunctivitis, eye muscle strain, and other conditions were found; astigmatism was the most common, appearing in 54 instances.

English War-Blinded Civilians.—In January, 1943, one hundred civilians in Britain were known by the National Institute for the Blind to have lost their vision as a result of enemy action. This figure does not include eyesight casualties in the civil defense services.

Red Army Has Way of Speeding Dark Adaptation.—Soviet physiologists now possess methods which infallibly secure maximum adaptation of the human eye to darkness within five or six minutes

after passing from light to darkness, Krikor Kekcheyev, Nikolai Derzhavin and Sergei Pilipchuk of Moscow declare in a recent issue of *War Medicine*.

In their cabled article, the three scientists say that "An important problem in war is that of expediting the period of adaptation of the eye in passing from light to darkness. Until recently only one method of shortening this period was known: If before passing into darkness a person was kept in weak, instead of bright, light, it was possible to reduce the period of adaptation from forty-five or fifty minutes to twenty-five or thirty minutes. Soviet physiologists now possess methods which infallibly secure maximum sensitivity not within half an hour but within five or six minutes after passage from light to darkness."

Although the method is not described by the three authors, apparently it includes weak excitations of the organs of sense of hearing, taste or smell, which, they say, thereby increases the sensitivity of other sense organs, such as the eye. They say it also has been found that the stomach, intestine and bladder should not be too full if good night vision is to be obtained, and that it has been demonstrated that changes in the sensitivity of night vision could be obtained by conditioned reflexes (subconscious habits).

The three scientists point out that—"The present war has revealed the immense and formerly inadequately appreciated importance of night battle and reconnaissance operations and hence the equal importance of night vision. . . . What aspects of the physiology of night vision interest military men first and foremost? One of them is the problem of increasing the sensitivity of the eye in the dark. In principle, increasing the sensitivity of night vision does not present any difficulty. In fact, Soviet physiologists in past years have published a number of works on the mechanism of changes in the sensitivity of human sense organs. It was found that excitation of any one sense organ by a customary and adequate stimulus immediately causes a change in the sensitivity of other sense organs, either heightening it or diminishing it. Academician L. Orbeli called this phenomenon interaction of afferent systems. It was soon established that weak excitations of the organs of sense of hearing, taste or smell enhance the sensitivity of other sense organs, including those of sight, whereas strong excitations have the opposite effect.

"The action of such stimuli on the thresholds of night vision proved to be prolonged, and it sometimes requires one and a half hours before the sensitivity of an eye adapted to darkness returns to normal. Further, it was discovered that the sensitivity of night vision is one of the most fluctuating functions of the human organism, but that it is 'possible, by selecting suitable stimuli for other sense organs, sometimes to increase the sensitivity of an eye already adapted to darkness to maximum by another 40 to 50 per cent.' The importance of increased sensitivity of vision in night reconnaissance and battle operations scarcely requires stressing. It is a matter in which every sentry scout, every infantry, artillery or naval observer and every night pilot is interested.

"In the course of investigating this problem several highly interesting details were revealed. . . . It is now clear that the sensitivity of human sense organs is directly dependent on the state of fulness of the stomach, the intestine and the bladder. Hence, it is important in responsible reconnaissance operations that the visceral organs of the abdomen and the pelvis should not be overcongested. Other factors tending to diminish the sensitivity of the eye adapted to darkness (such as fatigue) were also ascertained and studied.

"In 1936 and 1937 there appeared almost simultaneously three reports on research . . . demonstrating that changes in the sensitivity of night vision could be obtained by conditioned reflexes. The weak and undifferentiable sound of a metronome or a tuning fork, it was found, may evoke great changes if it is combined several times with active factors, for example, with taste, cold or sound stimuli. What Academician Pavlov demonstrated for secretory reactions (salivary gland) can now be extended to the mechanism of change in the sensitivity of sense organs. This is explained by the fact that the change is produced by the sympathetic nervous system. . . ."

Illinois Vision Testing Project.—Since 1936, 1,466,510 school children in Illinois have had their vision tested under a project co-sponsored by the Illinois Society for the Prevention of Blindness and the WPA. Over 77,000 children were found to have defective vision, and of these, nearly 53,000 had their vision corrected. With

the assistance of Chicago ophthalmologists, workers were given a course which included anatomy and diseases of the eye, refractive errors, squint, public relations with the schools, and vision testing procedures. The workers were trained to give the regular Snellen chart examination.

Report on the work was presented at the meeting of the Illinois Medical Society in May, 1942. The Illinois Society for the Prevention of Blindness has demonstrated beyond doubt the feasibility of a project such as this; however, the large-scale collaboration of the WPA is, of course, no longer possible due to the enormous cuts this agency has taken with the rising curve of employment.

"Eyes for Service."—Under this title the Society has issued its 28th Annual Report, for the year 1942. Because of the need for wartime economy the Society is not extending the circulation of the Report as widely as in previous years, but single copies may be obtained upon request.

William Fellowes Morgan, 1860-1943.—We report with sorrow the death of the Society's President Emeritus, William Fellowes Morgan, on May 7, 1943. Mr. Morgan was the first President of the national organization and served in this capacity from 1916 until his retirement in 1940. His leadership throughout this quarter of a century was a notable factor in the development of the prevention of blindness movement, which was unusually fortunate in having the invaluable guidance of one experienced in administrative, financial, and legislative fields. With his death the Society has lost an old and devoted friend and sponsor.

Augustine J. Smith, 1868-1943.—The Society is also grieved to report the death of Augustine J. Smith, a member of its Board of Directors, who served faithfully for some years. Mr. Smith's interest in preventing blindness and conserving vision grew out of his activities on behalf of the blind. He was their warm friend and participated in the councils of various organizations dedicated to their welfare. Because of his understanding of their needs, he gave much of his time and energy to transcribing books into Braille, thus making the writings of many authors available to persons without sight.

Current Articles of Interest

Primary Hereditary Nystagmus, Mary Allen, M.D., *Journal of Heredity*, December, 1942, published monthly by the American Genetic Association, Thirty-second Street and Elm Avenue, Baltimore, Maryland. A pedigree is given of a primary hereditary nystagmus which appeared to be dominant and not sex-linked. There was no defective macula, no history of albinism. The pattern of transmission was irregular dominant.

A summary states:

"1. Case histories are given of four children with a nystagmus fitting Waardenberg's classification of Primary Hereditary Nystagmus; dominant type.

"2. Vitamin D deficiency concomitant with this condition could easily cause confusion of the condition with spasmus nutans in the younger children if family history had not been investigated.

"3. The lesion is probably of central nervous system origin, and individuals in this group having the more stable nervous system had the less noticeable defects.

"4. The family tree is given because the condition seemed rare enough to warrant reporting as many individuals as possible in the group.

"5. According to ophthalmologists, errors of refraction in these cases should be treated as in cases without nystagmus."

Exophthalmos Associated with Thyroid Disease, Algernon B. Reese, M.D., *New York State Journal of Medicine*, October 1, 1942, published bimonthly by the Medical Society of the State of New York, 292 Madison Avenue, New York, N. Y. The operative procedure of choice for cosmetic purposes is indicated in the cases of: (1) hyperthyroidism in which the retraction of the upper lid, and not exophthalmos, is the principal cause of disfigurement; (2) disfigurement caused mainly by exophthalmos; and (3) disfigurement caused by both retraction of the upper lid and exophthalmos. Operative treatment is also indicated for cases in which exposure of the cornea is imminent, both when malignant exophthalmos is present and when that condition is not present.

Nystagmus Through Four Generations, Marion LeRoy Billings, *Journal of Heredity*, December, 1942, published monthly by the American Genetic Association, Thirty-second Street and Elm Avenue, Baltimore, Maryland. The author presents a report and diagram of nystagmus, sex-linked recessive type, which has appeared through four generations, with a definite transmission from affected males to half their daughters' sons.

Developmental Cataracts, Harold F. Falls, M.D., *Archives of Ophthalmology*, February, 1943, published monthly by the American Medical Association, 535 North Dearborn Street, Chicago, Illinois. Dr. Falls summarizes the results of surgical treatment in 131 cases of developmental cataract at the ophthalmic clinic of University Hospital in Ann Arbor, Michigan, between the years 1925 and 1942. In all cases the cataract had been noticed at birth or shortly thereafter. No patient was operated on if the visual acuity was shown to be better than 6/15. Proved inheritance or familial tendency was present in 16 per cent of cases, and continuing investigation in the genealogic trees in many cases indicates that a greater percentage may be expected.

Fifty-five per cent of patients were operated on under the age of 8 years, 17.5 per cent under the age of 2 years. Twenty-five per cent of all failures occurred in patients operated on during the first year of life. However, it must be taken into consideration that these children offered in any case a poorer prognosis, since they had complete cataracts, whereas the children who were allowed to reach school age had sufficient preoperative vision to enable them to get about.

With regard to final visual acuity, the best results were obtained when the patient was first operated on between the ages of 4 and 10 years.

Operative techniques are described.

The frequency—52.6 per cent—of associated ocular disturbance such as nystagmus, strabismus, microphthalmos and subluxation of the lens emphasizes the tendency toward defective germ plasm present in these patients. In addition, general constitutional disturbances, either congenital or metabolic, appeared in 29.7 per cent. The author recommends that the ophthalmologist be cautious

in prognosticating normal mental development after a successful operation, despite the numerous reports citing pronounced postoperative improvement in intellectual status, for he found actual cerebral developmental dyscrasia to be frequently present. Four patients in this series were institutionalized for mental deficiency.

Dr. Falls offers the following conclusions and recommendations:

"1. Persons with developmental cataracts are extremely likely to have associated ocular or constitutional congenital anomalies. These persons have poor protoplasm.

"2. It is suggested that in the case of complete bilateral cataracts, operation be performed on one eye after the patient reaches 6 months of age. The other eye may be surgically treated after the age of 2.

"3. If the cataracts are incomplete and the child can get around, surgical intervention should be postponed until the third or fourth year of life.

"4. In the present series, in very young children discission of the lens capsule proved to be the safest technique, and although complications were frequent they were fortunately minor.

"5. The best visual acuity was obtained when the combined technique of discission and linear extraction was employed.

"6. Of 233 eyes, 83, or 35.5 per cent, obtained a final visual acuity of 6/12 or better and have permitted the patients to maintain a useful place in society.

"7. Contraception is urged when the cataract is familial.

"8. Sterilization is recommended when the offspring displays a lenticular defect which is proved hereditary.

"9. Surgical intervention in early life is hazardous, as shown by the fact that a high percentage of complications and 33 per cent of the total failures (from light perception to no vision) occurred in the age group under 2 years."

Compensatory Divergent Strabismus, C. A. Clapp, M.D., *Southern Medical Journal,* January, 1943, published monthly by the Southern Medical Association, Birmingham, Alabama. The author states that skiascopic refraction should be attempted, whereas operative intervention designed to straighten the eyes is absolutely contraindicated, for if made parallel by operative procedures, they eventually assume the bilateral divergence. Divergent strabismus in very young children, where a bilateral chorioretinal atrophy or coloboma exists, is infrequently seen.

Discovering the Student with Impaired Vision in the Schools, James Houloose, M.D., *The Journal of Health and Physical Education*, December, 1942, published monthly by the American Association for Health, Physical Education and Recreation, 1201 Sixteenth Street, N.W., Washington, D. C. The new philosophy that education has to do with the whole child, and not with just his intellectual function, makes it the responsibility of parents, teachers, and administrators to see that the child's sensory avenues of experience are maintained at their highest efficiency. Many authorities say that a child with a mental age of less than six and a half should not be required to begin the phases of education which involve reading and writing. Physical immaturity, especially immaturity of vision, is an important factor in reading disability.

The author considers the theory that educational programs of today are "eye destroyers." The practice of basing admission and, in general, administration of the school program on chronological age, without paying attention to perceptual and other variable physiological abilities, is thought by some educational psychologists to be harmful. Inadequate lighting, the prevalence of glare and bad typography, and the use of old-fashioned flat-topped desks for reading are some of the stumbling blocks to good vision to be found within the classroom itself. The large number of eye defects that remain uncorrected after being found is due to many factors, including lack of correct recording on school health records, lack of follow-up, lack of facilities, and low economic level. The greatest factor, in the experience of the author, is lack of parental interest. ". . . On the basis of a combination of Snellen and Keystone Telebinocular tests of 365 specially referred children, 136 parents were sent recommendations for refraction. In the following up the next semester, we found that 8 parents had completed the recommendation, 79 promised to follow the recommendation soon, and 49 assumed and acted on the principle that the recommendation need not be followed." In other words, not only must reports be followed up, but parents must be convinced that there is a need. The detection of defects and conservation of vision are thus seen as dual obligations.

An eye health program evolves from the school health department's choice of (1) how and (2) when it will find the student with

impaired vision, (3) what it will do about the findings, and (4) whether it will initiate a sight conservation and a preventive program.

Slit-Lamp Microscope in Nutrition Surveys, J. H. Kodicek, M.D., and John Yudkin, *The Lancet*, Vol. 243, No. 6626, December 26, 1942, published weekly by The Lancet, Ltd., 7 Adam Street, London. Another contribution to the literature on the subject of the relationship between vitamin A and epithelial changes and that between riboflavin and corneal vascularization is summarized by the authors as follows:

"An examination with the slit-lamp microscope has been made of the eyes of 496 elementary-school children in Cambridge, aged between 8 and 11 years.

"Corneal vascularization, taken as an actual invasion of the clear cornea with vessels from the limbus, and said to be indicative of deficiency of riboflavin, has been found in about 4 per cent of the children. The proportion was significantly higher in older than in younger children.

"The importance of examining the epithelial layer of the conjunctiva is stressed. Reasons are given for supposing that this is more likely to show changes due to dietary deficiency, especially deficiency of vitamin A, than examination of the subepithelial tissues according to the method of Kruse and his co-workers. Opacities in these subepithelial tissues have not been observed in the children examined by us.

"Our observations have led us to classify the various findings in the epithelium into 5 groups. The first contains those children whose conjunctival epithelium is perfectly smooth and transparent, while the other groups contain those showing varying degrees of wrinkling and opacity. It is suggested tentatively that these represent 5 grades of increasing severity of change.

"The factors which appear to affect the production of these epithelial changes are age, economic status and sex. Thus, children with smooth transparent conjunctival epithelium (group 1) are less common at the higher ages, in the poorer school, and amongst boys rather than girls. It must be emphasized, however, that we do not know the cause of these epithelial changes; in particular, we do not claim at this stage that they are due to deficiency of vitamin A."

Book Reviews

READING AS A VISUAL TASK. Matthew Luckiesh, and F. K. Moss. New York: D. Van Nostrand Company, Inc., 1942. 428 p.

Reading is recognized to be a difficult, energy-consuming task, consequently any efforts to ease the process for the scholar or worker are eminently worth while. The authors, recognized experts in illumination research, in undertaking the scientific research studies reported in this book have sought facts that could be applied to improve conditions that affect ease of reading, to ascertain under what conditions various deleterious effects can be minimized. They admit that reading is far more than a visual task, but observe that conditions that affect seeing while reading are highly important.

Intuitive judgments in matters of illumination and factors that affect ease of reading are not to be trusted. Objectively determined criteria established with laboratory controls eventuating in standards expressed in terms of measurement are essential to eliminate guesswork in determining the factors that affect the reading task. With these objectives in view, the authors have conducted a notable series of research studies over a period of years that afford a sound basis for establishing standards having practical applications.

Instead of *legibility* the authors prefer *visibility* and *readability* as describing more accurately the criteria for evaluating physical factors that affect reading—duration of the task, glare, type size and face, line length, paper and inks. Factors involved in visibility are evaluated with the authors' Visibility Meter; the criterion chosen for determining readibility is the involuntary eye-blink. Speed of reading is considered as an undesirable criterion for this purpose because it is subject to voluntary control by the reader. The eye-blink is obviously an extremely limited criterion for the purpose, the reliability of which varies with the conditions under which it is tested. This fact the authors themselves admit when they describe the precise laboratory conditions under which it has been necessary for them to operate to obtain reliable results. Some of their conclusions appear to be based on rather tenuous evidence derived from comparatively small numbers of cases.

The authors have intentionally avoided becoming involved in

the psychological factors that are a part of reading. They have controlled certain of these factors in part by using uniform content and experienced adult subjects with superior educational background. Under these conditions it is obvious that the whole story has not been told. We know little about how comprehension difficulties affect reading efficiency in these experiments. Whether standards based upon work with highly literate adults can be applied directly to juvenile readers is another question.

At many points the practical applications of the research findings to easing the reading task are indicated. Chapter 13 gives a summary of the optimum specifications for readability in terms of type-size, spacing, line length, illumination, type-face. A practical illustration of how the findings may be applied to a problem involving the preparation of printed material is included. The application of the findings to establishing standards for sight-saving classes is given considerable attention. The need for better illumination for the visually handicapped reader is stressed above all other factors. In this connection there is a brief description of the most common visual deficiencies.

A glossary of the technical terms used is appended and reproductions of text printed in various type sizes and type faces are included. The bibliography contains references to the many separate research studies on which the contents are based.

The authors have practiced what they preach in applying their findings in constructing this volume which is a model in arrangement and typography. Excellent charts, ingenious diagrams and a number of photographs showing the laboratory equipment used in the experiments add much to the reader's understanding of the context.

The contents will be of most interest to the specialist who must make decisions regarding lighting conditions, who must prepare graphic materials for publication; or for those who require information concerning visual standards for sight-saving classes. There is some repetition in the book that might have been eliminated, and some orientation material is placed in the back instead of the forepart of the book where it would have been most helpful. This book calls for serious study of every section for the fullest comprehension of its contents.

—GERTRUDE HILDRETH, PH.D.

OFTALMOSCOPIA CLINICA (Clinical Ophthalmoscopy). Tomas R. Yanes. Habana: Biblioteca Medica de Autores Cubanos. 1943, 500 p. illustrated.

This book is the outgrowth of a course given to general physicians at the Eighth National Medical Congress of Cuba. It is primarily intended for medical practitioners and students, but the author has covered the whole subject of ophthalmoscopy adding several chapters at the end of the book. The edition of original books in Latin America, with probably the exception of Argentina, is a difficult and costly enterprise and rarely a financial success. It is probable that Dr. Yanes had difficulty in printing and especially in illustrating his book. He had to use reproductions of Oeller's *Atlas of Fundus Diseases* for all the color pictures. Unfortunately the black and white illustrations are mainly photographs which do not show well. Some of them are blurred and lacking in detail, failing to give the reader an accurate idea of the conditions represented. Perhaps in later editions Dr. Yanes may be able to correct these defective pictures, thus enhancing the value of his book.

The description of the fundus in the normal eye is well made in a brief and comprehensive way. The descriptions of fundus diseases are short and made especially from the clinical standpoint. Rarely is there any pathological basis sought for the explanation of symptoms or fundus disturbances. The author has added at the end an interesting chapter on "The Prognosis from the Standpoint of Fundus Lesions" in which he reviews diseases such as syphilis, tuberculosis, renal conditions, diabetes, and cerebral tumors.

The book is timely and will bring the subject of medical ophthalmoscopy to the attention of general physicians, encouraging a more widespread use of the ophthalmoscope.

—MANUEL URIBE TRONCOSO, M.D.

WHY WE HAVE AUTOMOBILE ACCIDENTS. Harry De Silva. New York: John Wiley & Sons, 1942. 394 p.

No one can read Dr. De Silva's book without the feeling that traffic safety is gradually becoming a science. For the author has constructed the pattern of his chapters by carefully weaving into the text the results of over a hundred research studies and reports of findings. Dr. De Silva's wide experience, first with the Bureau for Street Traffic Research at Harvard, and later with the Esso

Foundation at Yale under the direction of the American Association of Motor Vehicle Administrators, has given him an unusual background of technical research and practical application.

Since traffic safety is relatively new, it is refreshing to see the number of able studies that have been conducted in order to prove some of the procedures in reducing accidents. The first chapters of the book deal with the highly important subjects of driver testing, license examinations, and the basic causes of accidents. It is in this field especially that the author has made his greatest contribution. He shows that good vision is one of the most important requirements of the safe driver, and presents evidence to prove that lack of visual acuity, poor peripheral vision, inability to withstand glare, and other visual weaknesses may be important basic causes of traffic accidents.

Those who are familiar with Dr. De Silva's work know that he had much to do with the improvement in the State License Examination and the preparation of model drivers' manuals that have been adopted and widely distributed throughout the country. However, one is impressed with the fact that actual practices, such as examination of drivers, the enforcement of regulations, and educational procedures to train drivers lag far behind our knowledge and information as to the best methods. There are still far too many states with inadequate license laws, ineffectual education and enforcement programs, and poorly developed traffic court procedures.

An important part of the text is concerned with a program of education, enforcement, and engineering, under the leadership of state and national agencies, with co-operation from private agencies such as safety councils, automobile clubs, and insurance organizations. The author offers some excellent suggestions for carrying on co-ordinated programs.

What effect is the war to have on our traffic problems? We are already witnessing many changes because of priorities, rationing, and the rubber shortage. The use of the motor car for travel is steadily decreasing, and accidents show a downward trend. But the automobile problem will always be with us. We can but hope that this period will be a time for traffic authorities to take stock and plan more adequate procedures, so as to be ready for a more sensible and vigorous attack on the traffic safety problem.

—HERBERT J. STACK, PH.D.

VISION, A STUDY OF ITS BASIS. S. Howard Bartley. New York: D. Van Nostrand Co., 1941.

Dr. Bartley has written a highly technical book which includes much of the psychologic and physiologic data that have accumulated concerning the visual process. Important material has been omitted, however, including among other things the entire field of color vision. The book is far from being a complete compendium of visual physiology, as its title might imply.

The first step in the visual process is a photochemical one, occurring in the cone and rod cells of the retina. These cells emit neural impulses as a consequence of photochemical activity, in the same manner that the end organs of every sense give rise to neural impulses when they are acted upon by external stimuli. It is only the fact that the sensory cells of the eye are sensitive to light which makes the eye an organ of vision. The specific properties of vision can therefore be best studied by the behavior of the cone and rod cells.

The neural impulses from these cells are relayed through various synapses in the retina and the brain until visual perception is achieved. Dr. Bartley's background is that of a psychologist and neurophysiologist; for this reason he places great emphasis on the neural factors involved, minimizing the primary photochemical nature of vision. It is the interaction among the neural relays of the retina, the bipolar and ganglion cells, which, Dr. Bartley contends, is the determining factor in most visual experiences. However, the evidence he cites to support this thesis is often highly dubious.

Because of the technical nature of the book it will interest only those who are somewhat familiar with visual physiology. Since the contents do not by any means stress the most important aspects of retinal physiology but instead are selected to illustrate the author's thesis, it will be necessary for the reader to apply a critical faculty in evaluating it.

—JOSEPH MANDELBAUM, M.D.

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